# Gas Journal

LIGHT - HEAT - POWER - BY-PRODUCTS

Vol. 246. 97th Year. LONDON, AUGUST 8, 1945. No. 4290. Price 1/-

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AUG 24 1945



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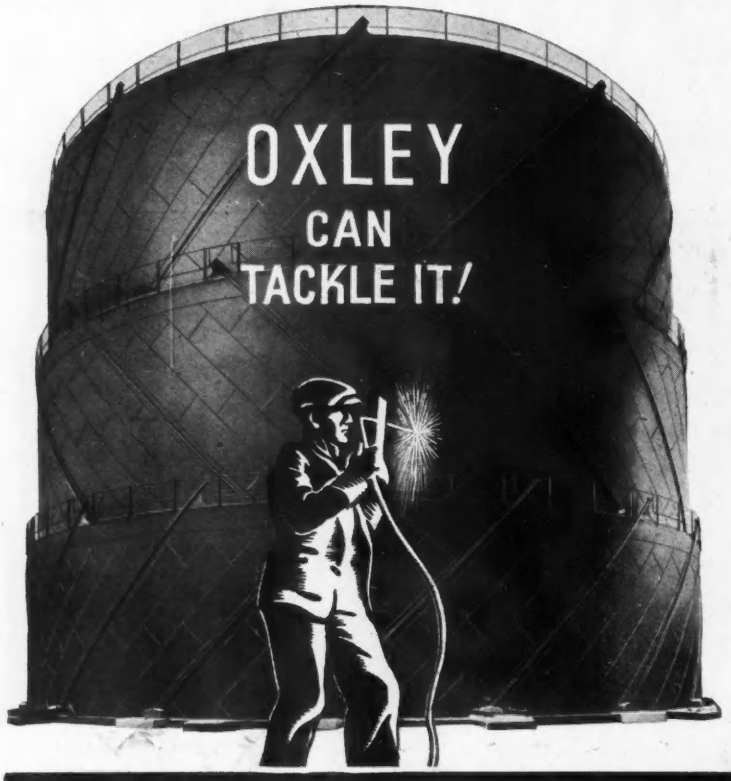


From a gasholder of much improved design, or tanks, stills and vessels fabricated by arc welding, to the repair of gasholders, purifiers and other equipment weakened by age or corrosion—Oxley can tackle it. Oxley experience and ingenuity are at the service of the Gas Industry.

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**Suitable for Inlet Pressure up to 22" w.g., but can be made for higher pressures if required. The Governor is set for 2·8" Outlet Pressure, but can be weighted to give higher pressures if desired. Capacity—300 cu. ft. per hr., with a pressure loss of less than ½" w.g.**

**This Diaphragm Governor has been developed to meet conditions which will be generally found in the new houses now being erected. :: Many thousands have been delivered already.**

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**Gas Works Plant Engineers, CHESTERFIELD**

# GAS JOURNAL, AUG. 8, 1945

VOL. 246 97th YEAR No. 4290



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*for Handling Coal or Manganese Ore*

*Capacity*

2,000 TONS per HOUR

Designed, Constructed and Erected at Durban by

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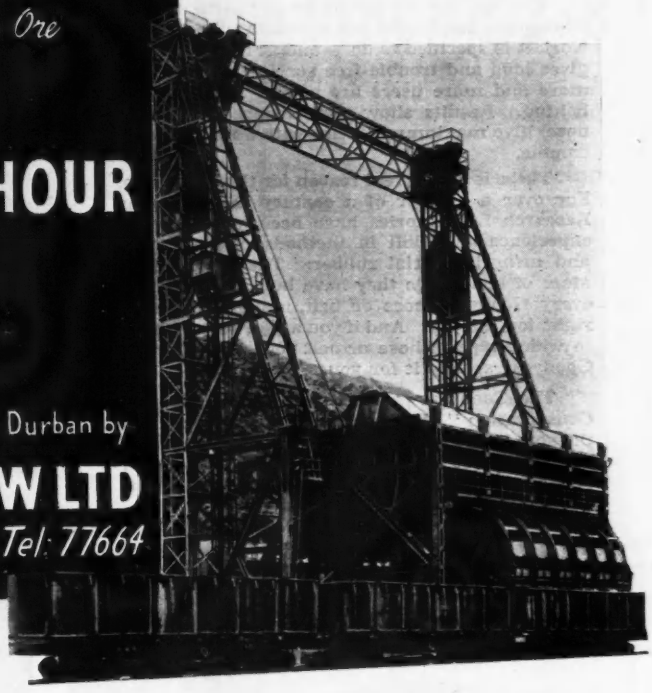
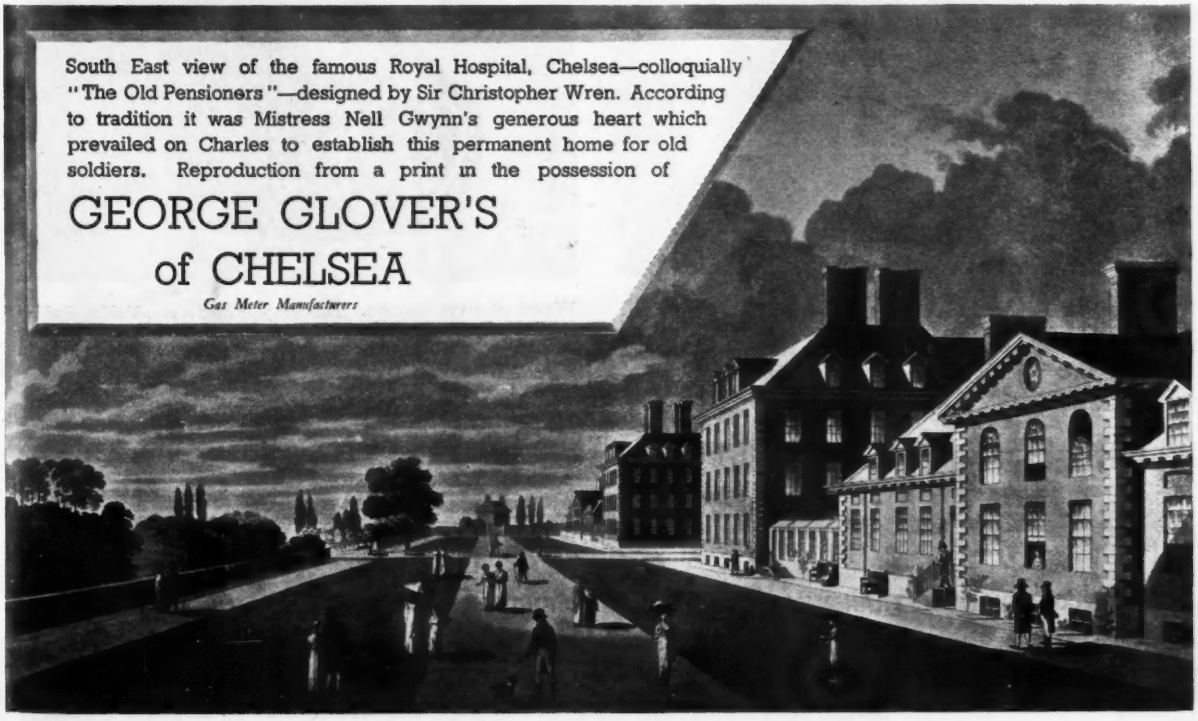


South East view of the famous Royal Hospital, Chelsea—colloquially "The Old Pensioners"—designed by Sir Christopher Wren. According to tradition it was Mistress Nell Gwynn's generous heart which prevailed on Charles to establish this permanent home for old soldiers. Reproduction from a print in the possession of

GEORGE GLOVER'S

of CHELSEA

*Gas Meter Manufacturers*



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**The best belt you can get for any particular job you have in hand is the belt that does efficiently the work it is specified to do — and at the same time gives long and trouble-free service. That's why more and more users are asking for Goodyear belting. Results show that Goodyear belts (or hose) give maximum service with a minimum of trouble.**

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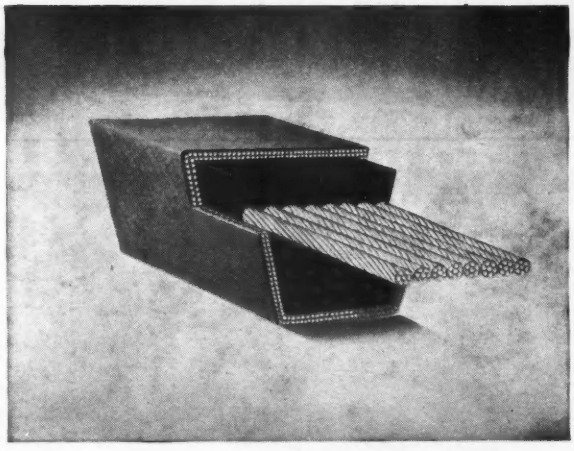
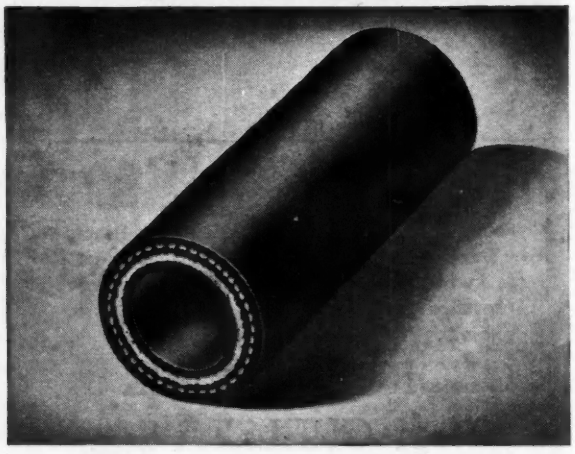
**The Goodyear "Industrial Rubber Products Conservation" Handbook is to-day accepted as the standard work on the maintenance of hose or belting. Write for a copy, and send your technical problems as well, to: The Mechanical Goods Dept. (G.J.), Goodyear, Wolverhampton.**



**V-Belts.** The Goodyear high tensile, low stretch endless cord construction is unsurpassed in flex life and fatigue resistance. Accurate cross section secures perfect grip in sheaves. Matched belts ensure even load distribution, resulting in lower operating costs.



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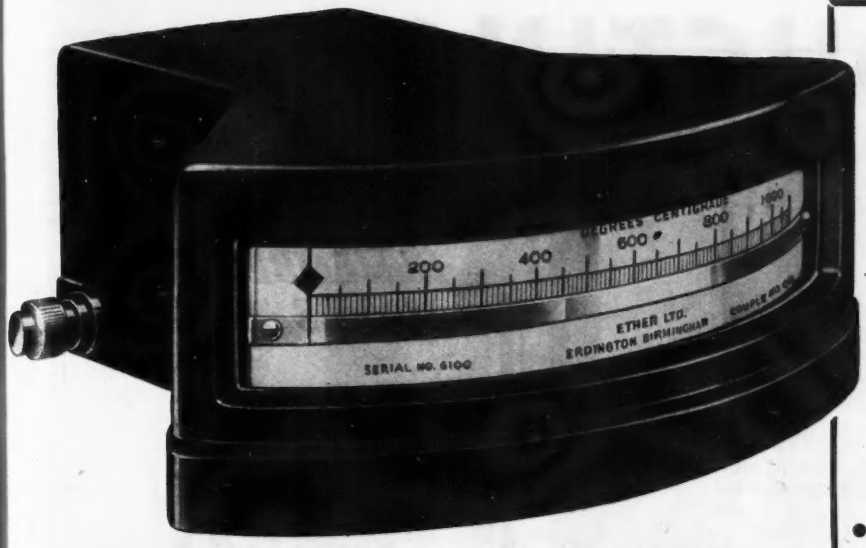


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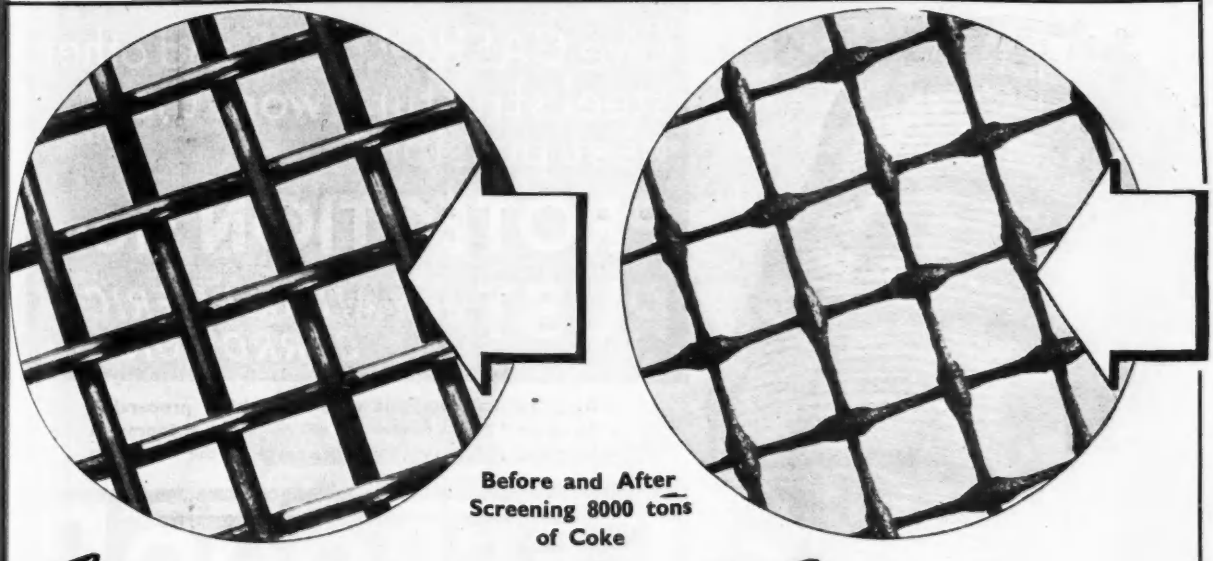

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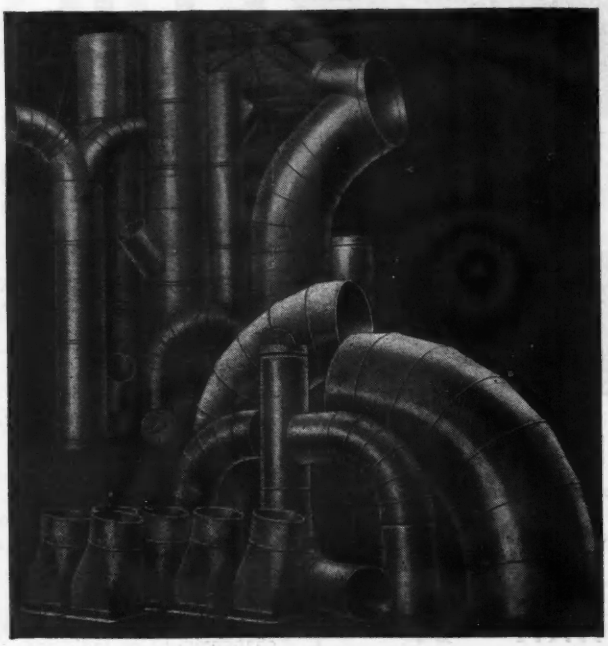

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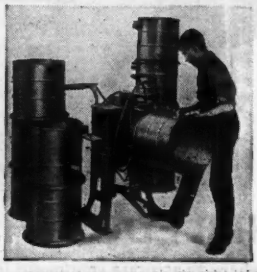

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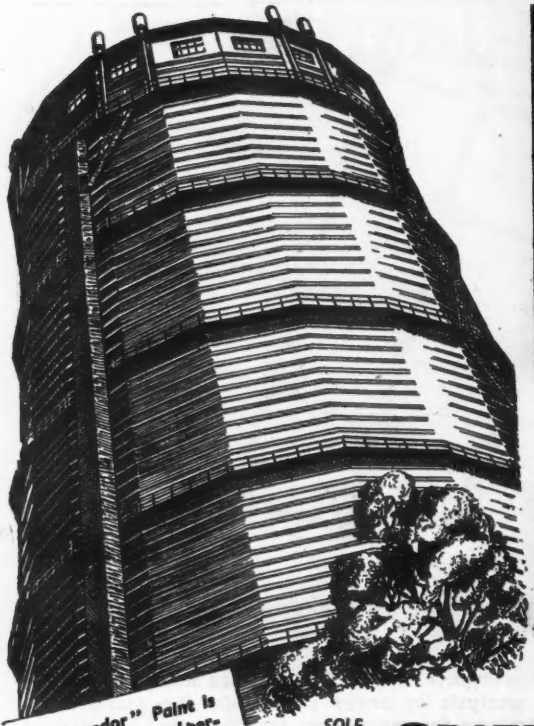

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# plant for the Gas Industry

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VERTICAL AND HORIZONTAL WATER TUBE, ATMOSPHERIC AND DIRECT SPRAY TYPES

**W.W-D. ELECTRO-DETARRERS**
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FOR TAR, LIQUOR AND OIL

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2. Designers and chemical engineers experienced in the Industry's needs.
3. Works manufacturing facilities greatly enhanced by war production experience.
4. Erection, operating and service staff skilled in their duties

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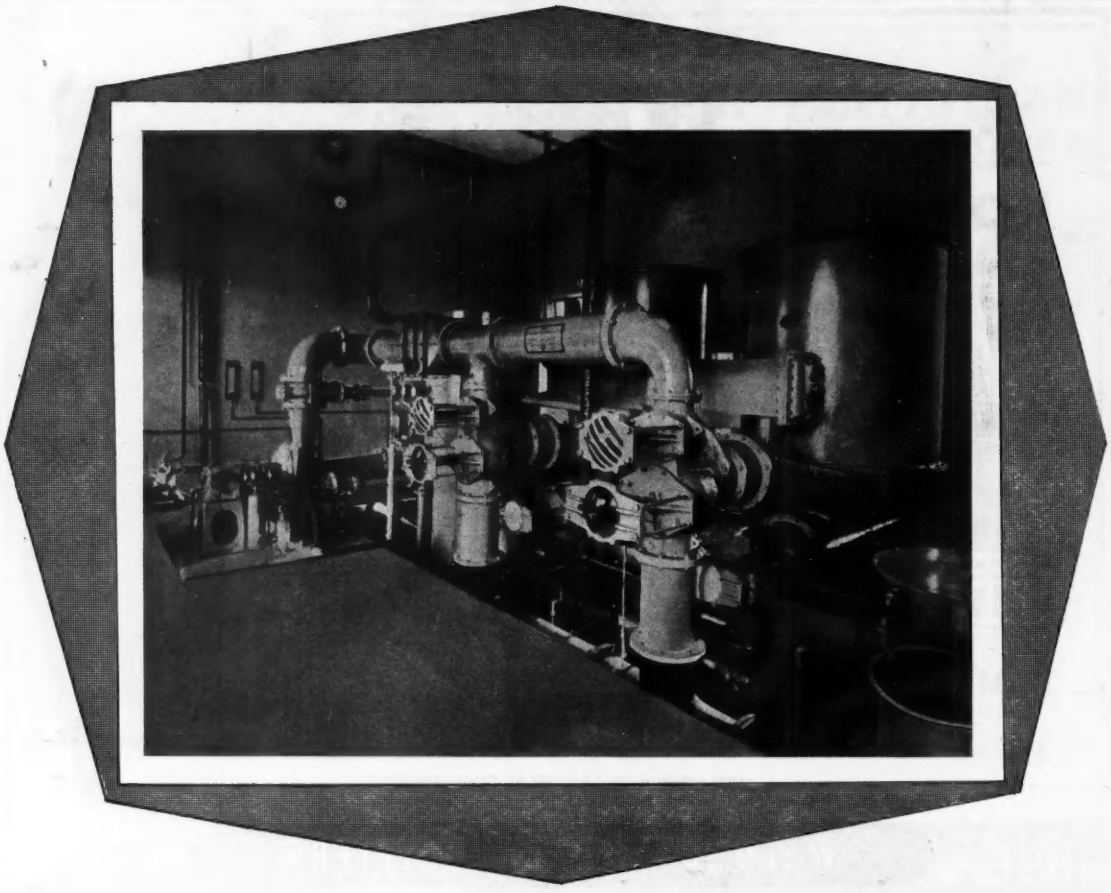

# What experience means to benzole recovery in the Gas Industry!

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They are the result of over 20 years' experience in the manufacture and use of Active Carbon for recovery purposes in every branch of industry where solvents are used. They range in size from a capacity of quarter of a million cu. ft. per day, up to 86 million cu. ft. per day, recovering millions of gallons of valuable solvent per annum, which would otherwise have gone to waste.

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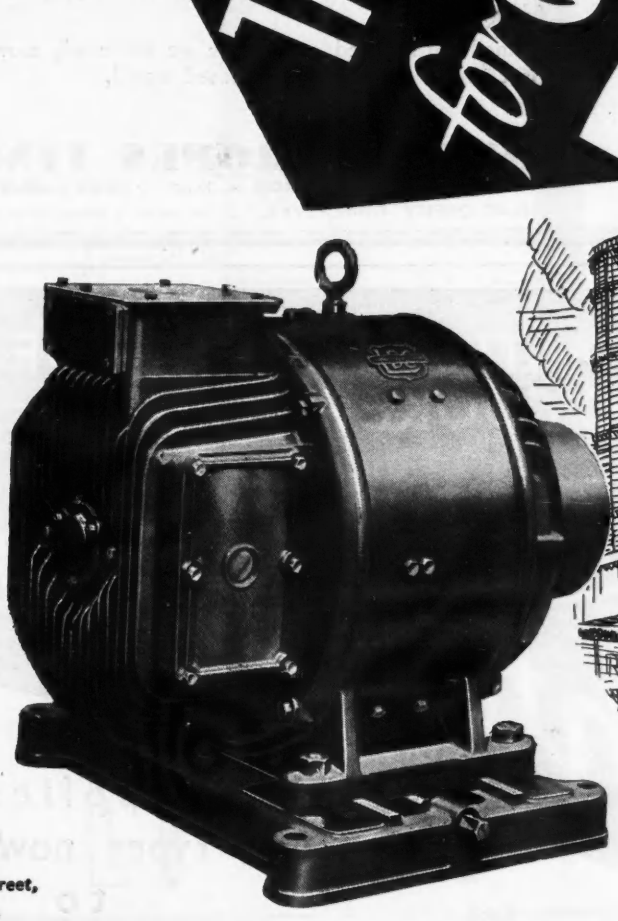

**L.D.C. Motors are specially designed and constructed to give lasting and reliable service under the arduous conditions which prevail in Gas-works.**

**Mica insulation for reliability.**

**Absolute dust-tight construction.**

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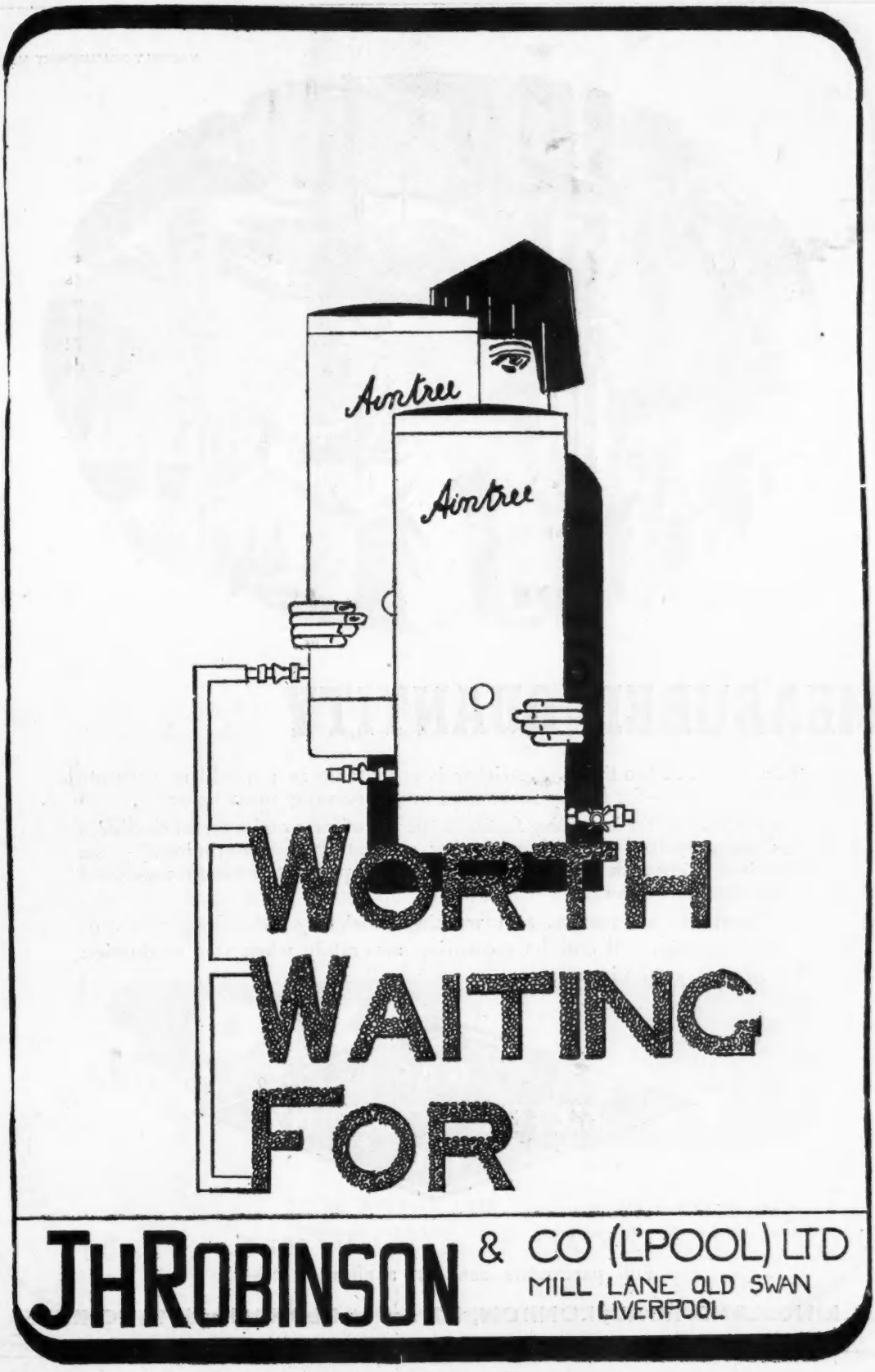
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The Gas Meter is a ruling factor in the use of gas; on its metal shoulders lies the perpetual task of measuring accurately and continuously — an ever-increasing task as new channels of vital production make more and more demands upon it.

Countless gas meters, still working efficiently after long years of wartime strain, will still be measuring accurately when war production has been forgotten in peace.

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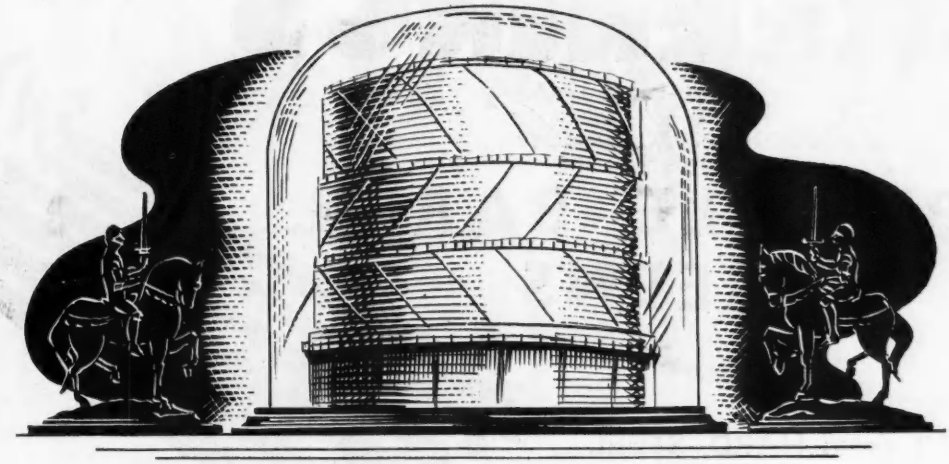

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Equally effective and more practicable for gas holders is a coat of the paint that won't crack—Dixon's Silica-Graphite Paint, famous for its adaptability to changes of temperature. It provides the longest life under all climatic conditions. Whatever your paint problem Dixon's will solve it—and more economically too. We invite you to get in touch with us.

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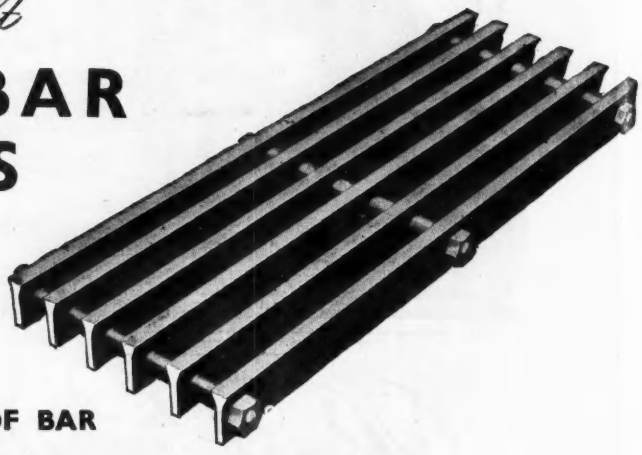

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The
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The special feature of this pump is that the pump bucket works entirely outside the liquid.

18 Gallons, £20 2 6

*Other patterns of smaller capacity and lower prices.*

*Above price plus 10% advance. Owing to the National Emergency all prices are subject to conditions prevailing at the time orders are received.*

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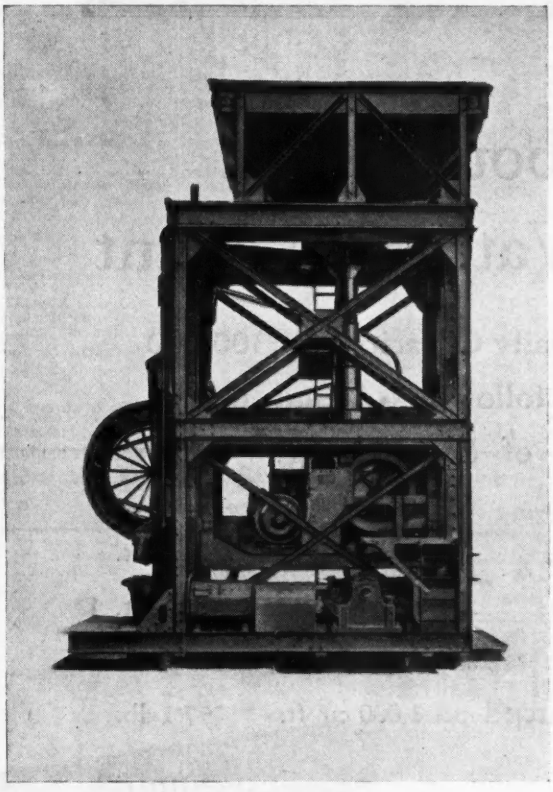
# The part we have played 1939-1944



*IN* meeting the heavy volume of war-time demands and to ease the arduous conditions of manual labour, the industry has in many instances overcome its problems by installing more modern and efficient mechanical equipment.

*OUR* difficulties have been no less in the supply of such equipment, but in the period under review we have for example been called upon to supply **34 DB stoking machines** for the charging and discharging of horizontal retorts.

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**Since it was first introduced nearly 400 DB stoking machines have been installed.**

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**having a Guaranteed Daily Capacity of 2,300,000 Cubic Feet gave the following *Actual Results* over a period of *Seven Days*:**

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| **Total Gas Made** .... .... .... .... | **17,732,000** cu. ft. |
| **Daily Rate** of gas production .... .... | **2,535,000** cu. ft. |
| **Calorific Value** of gas .... .... .... | **503·5** B.Th.U. |
| **Waste Heat Steam Produced** per 1,000 cu. ft. | **57·1** lb. |
| **Oil** used per 1,000 cu. ft. .... .... .... | **2·0** gall. |
| **Dry Coke** charged into generator per 1,000 cu. ft. | **27·1** lb. |
| **Carbon** consumed in generator per 1,000 cu. ft. | **22·9** lb. |

**H. & G. Water-Gas Plants range in Unit Capacity from 80,000 to 9,000,000 cu. ft. Daily.**

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***Established 1892***

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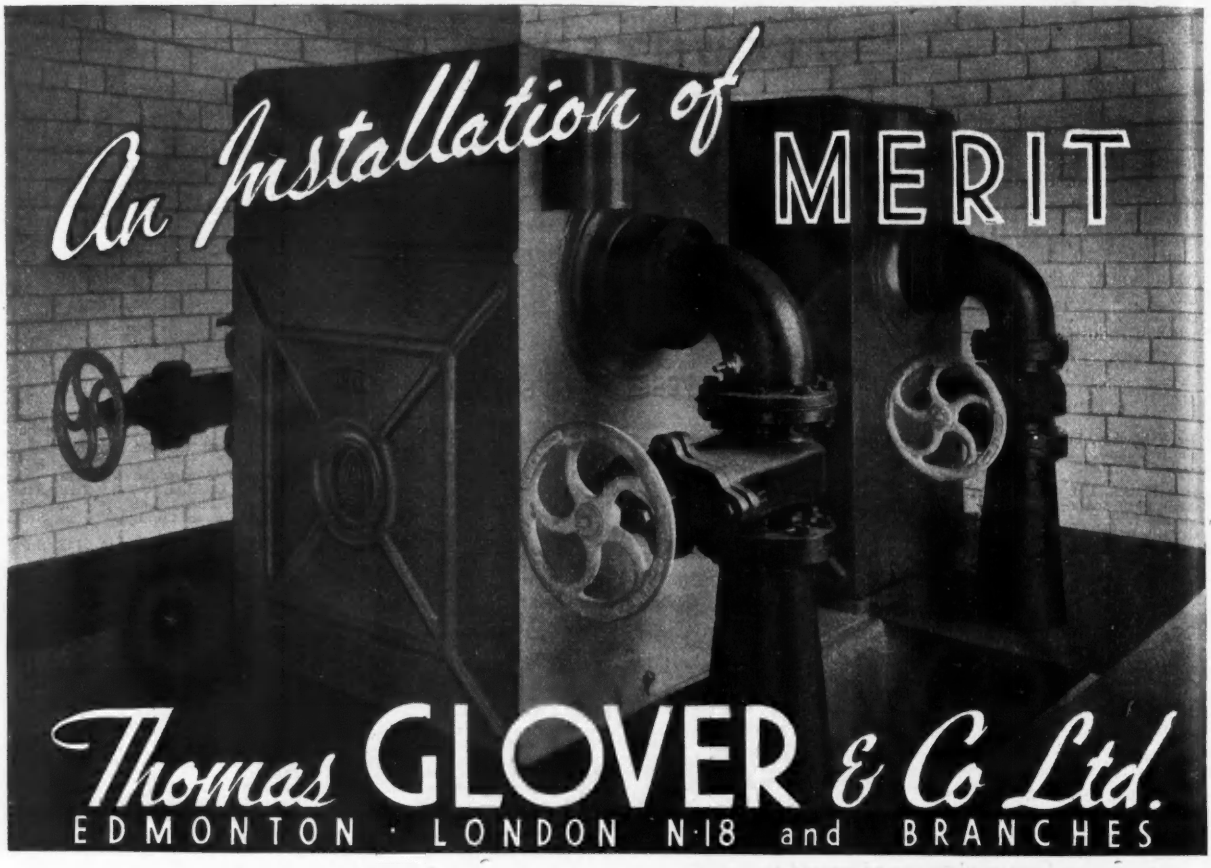


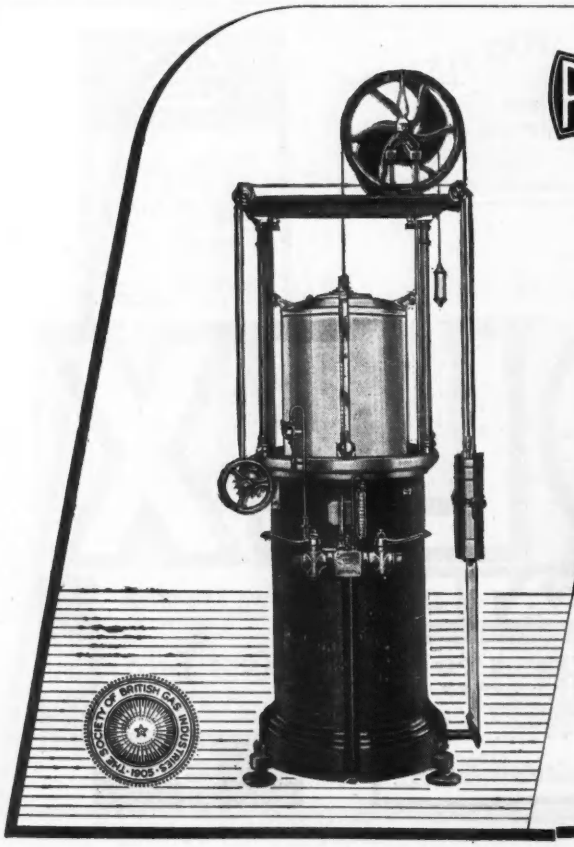

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# GAS JOURNAL, AUG. 8, 1945

VOL. 246 . 97th YEAR No. 4290


## EDITORIAL NOTES

### DISCOVERY AND APPLICATION

DURING the past three or four years, in discussions on post-war policy in industry generally, few words have been more conspicuous than that of "research," and, indeed, a great deal of practical financial encouragement has of late been forthcoming. The recent offer of £435,000 for the endowment of a school of chemical engineering at Cambridge, and £2,500 a year for scholarships, by the Shell group of oil companies is an outstanding but by no means isolated example of the recognition that research is vital to the progress of industry. Only a few days ago it was announced that research work in the steel industry is to be amplified by a central organization which will receive up to £250,000 a year from the industry and the total revenue of which will be in the neighbourhood of £400,000 a year.

Of late various associations and bodies have issued reports on the subject, and we have reviewed several of these in our columns. Had it not been for research and investigation, research both pure and applied, the Gas Industry would not have advanced as it has advanced, and it is altogether healthy that to-day our Industry as a whole takes a more lively and serious interest in research and investigation than at any time in its history, and is regarding the general problem in a clearer light and with a better understanding.

We return to the subject in view of the proceedings at the annual meeting of the Society of Chemical Industry in London last month, on which occasion much attention was given to research both in prospect and retrospect; and it seems to us that some of the opinions expressed have bearing on the question raised at the meeting of the Institution of Gas Engineers whether research by the Gas Industry has proved a revenue producer. As Lord Leverhulme pointed out in an Address given on the presentation of the Medal of the Society of Chemical Industry, there is always a danger that when a word, phrase, or slogan is repeated again and again it may become a fetish; the word may be research, leading some to believe that all that is necessary is to vote a large sum of money for it, or set up a new department, and that benefits will flow automatically. The picture is in reality no such tidy one.

### THREE FACTORS IN RESEARCH

RESEARCH—and this is directly applicable to Gas Industry research—presents three factors: Government, the universities, and industry itself. Government's role, as Lord Leverhulme said, is mainly one of encouragement, stimulation, and assistance, Of necessity the Government helps to make the scientists of the future, and it must take active part in the development of national resources. For many years we have had the Fuel Research Board. The role of the universities and kindred institutions lies primarily in the field of pure research. Thirdly there is industry itself, and applied science is constantly using the discoveries of pure science to create new human wants and to open up new fields for industry. In which regard we were particularly impressed with Lord Leverhulme's comments on the law of "supply and demand"—not, be it noted, the law of "demand and supply." The public never "demanded" the thermostatically controlled gas cooker, for example; it never demanded the multipoint gas water heater any more than it demanded moving pictures. Pure science made discovery; industry developed its practical implications and offered it as a new labour-saving device or a new form of entertainment. Public demand followed supply—surely a fundamental point to bear in mind, and part answer to whether research in industry is a revenue producer. From the study of the phenomena of electric discharge in vacua came the development of X-ray photography; it did not emerge from demand. Penicillin was not "planned" in the modern specialized meaning of that term.

### COMMON SENSE

WHILE the environment of industry is necessarily different from that of the universities, they need to be brought closer together than they have been in the past. "Let us see," said Lord Leverhulme, "whether the two cannot meet somewhere in the area of common sense." And he posed these questions: Where would modern industry be without the discoveries of pure research and without an intake of scientifically trained post-graduates? And where would universities be if industry ceased to function? And where would they be without the endowments which these activities have made possible? Fundamental and applied research are interdependent.

We turn to the views on research expressed by Professor Rideal in his Presidential Address to the Society. He feels there is danger in continued emphasis on the subject, that, in fact, evidence is lacking that we can increase the volume of "real" research in this country, though it may well be possible to make life easier for many aspirants. And he thinks that one of the major faults of industry is that between the production on the one hand and the research laboratory on the other there is in general too great a contact—that there should be a screen in the form of control and testing laboratories to deal with passing events, which screen, however, should not be impermeable, so that the research laboratory feels isolated. Even into universities, he believes, there is filtering the modern concept of "putting in a team" to deal with some branch or other of research; and such rationalization he regards as dangerous. As to Government departments in general, "in such organizations the personnel rapidly becomes static and stimulation from external sources feeble. . . . A complete secrecy blanket must eventually smother any initiative and originality." Nor is he of opinion that, by and large, our universities are completing the training required for modern chemical technology. Professor Rideal, it would seem, favours the individualist approach to problems to which a solution is sought in the "true spirit of enquiry." Yet our observation makes us value highly the team spirit approach in developing the implications of research on the practical scale. There have been several examples during recent years in the Gas Industry where the team idea has proved of real benefit, has acted as a time and a money saver, and yet in no way has cramped originality of thought, but, rather, has acted as stimulus.

Ouce again we turn to the Address by Lord Leverhulme. The spotlight of advertising (itself, by the way, demanding originality and imagination) is in industry directed to creating a demand for goods or services which may have been made possible only by the technical men in the back-room—and a gloomy back-room at that. The work done in a research laboratory—it may be on gas cooker or gas fire development—may not appear in a tangible form for the commercial man to handle for, shall we say, five years or more, during which period there is no spotlight or even general lighting effect on the back-room men. Here there would appear to be reason for taking a long view, and appreciating how greatly each type of worker matters to the other—that research, individualistic or corporate, should not be an isolated branch of industrial endeavour or, indeed, national progress.

§§

## Personal

Mr. J. L. ANDERSON, Acting Engineer and Manager of the Southport Gas Department, has tendered his resignation on account of domestic reasons and advancing years. It is six and a half years since Mr. Anderson was appointed at Southport; formerly he was with the Gas Light and Coke Company.

* * *

Mr. G. G. IBBOTSON has been appointed General Manager, Heavy Construction Division, Ironworks Branch, of Newton Chambers & Co., Ltd. He has been connected with the engineering activities of this Company for many years and has previously been responsible for control of production as General Works Manager, and more recently as Assistant General Manager.

* * *

Consequent on the decease of Mr. W. B. Richards, Mr. D. S. WOODLEY has been appointed Technical Manager and Chief Engineer, and Mr. D. M. BROWN Commercial Manager, of Keith Blackman, Ltd.

## Obituary

The death occurred on July 27 of Mr. W. B. RICHARDS, Director and General Manager of Keith Blackman, Ltd., in his 69th year. He joined the Company in 1892, was elected to the Board in 1929, and appointed General Manager in 1941. He served the Company with outstanding ability for 53 years, manifesting efficiency and enthusiasm in all he did.

## Presentation to Mr. G. le B. Diamond

The South-Eastern Civil Defence Region No. 12 comprises the Counties of Kent, Sussex, and Surrey, which have been more exposed to enemy attack than any other part of the country, and have necessarily played a prominent part in the Nation's defence and attack.

The mutual-aid scheme among the gas undertakings in that area has been of considerable importance and assistance in maintaining the public supply of gas without material interruption, often in exceptional circumstances. Take the experience of Dover, for example, which survived the continuous day and night attacks of the enemy, but 20 miles away, for over five years.

Throughout this period Mr. G. le B. Diamond (Rochester) has been the Regional Gas Engineering Adviser, and, following his recent resignation, there was a spontaneous movement throughout the Region individually to express appreciation of the invaluable services which he had ably and courteously rendered, in that capacity, to the general satisfaction of all concerned.

Arrangements were promptly made by a Committee consisting of Mr. P. E. Browne (Brighton), Mr. J. R. W. Alexander (East Surrey), Mr. S. E. Knowles (Eastbourne), and Mr. J. H. Hornby (Hastings), for the raising of a personal Presentation Fund. The result was that, on Wednesday, July 25, at the Dudley Hotel, Hove, almost every subscriber attended a luncheon at which Mr. Browne presented Mr. Diamond with three suitably inscribed silver fruit dishes. In responding to Mr. Browne's felicitous observations, Mr. Diamond recounted some of his experiences.

By a happy thought Mrs. Diamond had been asked to the luncheon, and she was given a presentation case containing a pair of silver sugar dredgers. The gathering concluded with an expression of appreciation to the Directors of the South-Eastern Gas Corporation for their public-spirited action in enabling Mr. Diamond to discharge the duties of Regional Gas Engineering Adviser and Deputy Regional Fuel Controller, which latter office it was hoped he would continue to hold, having regard to the problems with which undertakings were confronted, particularly in relation to labour and material.

## Diary

Aug. 16.—Domestic Development Committee: Gas Industry House, 2.30 p.m.
Sept. 7.—North British Association of Gas Managers: Annual Meeting, Glasgow.
Sept. 11.—British Gas Council: Gas Industry House, 2.30 p.m.

## Dividends

**Romford.**—Interim on Ordinary Stock 2½% actual, less income tax, on account of the year ending Dec. 31, 1945. This dividend will be payable on Sept. 1.

**South Metropolitan.**—Interim Dividend of 1½% actual on the Ordinary Stock for the six months ended June 30, 1945. Warrants will be posted on Sept. 18. (No Interim Dividend was paid last year on the Ordinary Stock and 2% was paid for the year.)

**Woking District.**—For the half-year ended June 30 at the following rates: On the "A" Ordinary Stock, £11% per annum; on the "B" Ordinary Stock, £7 14s.% per annum; on the "C" Preference Stock, £5% per annum; on the 4% Preference Stock, £4% per annum; all less income tax. Warrants will be posted on Sept. 1.

## Fostering Industrial Research

At a recent meeting of the F.B.I. Grand Council, under the chairmanship of the President, Sir Clive Baillieu, it was decided to convene in London a two-day conference on the subject of "Industry and Research." Special emphasis will be laid at the Conference—to be called in the late autumn or early spring—on the practical means by which research can assist industry and promote industrial efficiency, exports, full employment, and a higher standard of living.

The Federation has appointed as head of the F.B.I. Research Secretariat and Secretary of the F.B.I. Industrial Research Committee, Dr. B. J. A. Bard, B.Sc., D.I.C. The duties and functions of the F.B.I. Research Secretariat include the encouragement and fostering of industrial and national interest in research, maintaining contact with all industrial research organizations, and providing a service whereby advice, assistance and information can be obtained and contacts made. Close touch is being maintained with the Department of Scientific and Industrial Research, which is represented on the F.B.I. Industrial Research Committee. A first task of the F.B.I. Research Secretariat will be to organize and conduct a survey of existing research facilities in Britain. Among other activities, lectures and addresses will be arranged, and, where appropriate, articles written by members of the F.B.I. Research Committee.

Dr. Bard began his professional life conducting fuel research under the late Professor W. A. Bone, F.R.S., in the Chemical Technical Department of the Imperial College of Science and Technology. He then read for the Bar at Gray's Inn and practised at the Bar until the outbreak of war, after which he worked first with the Coal Commission and, later, on various industrial production and research problems at the Ministries of Supply and Aircraft Production. Members of the F.B.I. Industrial Research Committee include Dr. W. T. K. Braunholtz, Secretary of the Institution of Gas Engineers, and Sir Frank Smith.

## Portable Purging Machine

At a meeting of the representatives of gas undertakings in the South-Eastern Civil Defence Region No. 12, held on Sept. 2, 1942, at Gas Industry House, a Committee was appointed, under the Chairmanship of Mr. J. R. W. Alexander (East Surrey), to acquire, if considered desirable, a portable purging machine for the use of such undertakings, and accordingly to make all such arrangements as were necessary for the mutual establishment of an appropriate scheme for the finance, maintenance, and operation of the machine.

The Committee purchased a Holmes-Harrison purging machine and drew up a comprehensive agreement for its joint ownership and operation, such agreement being entered into by the 59 undertakings supplying gas in the region. Since Dec. 1, 1943, the machine has been stationed at the Crowborough Gasholder Station of the Tunbridge Wells Gas Company, whose Engineer and General Manager, Mr. J. W. Townsend, has acted as Operating Officer.

Among other tasks, the machine purged gasholders damaged by enemy action at Deal in December, 1943, and at Folkestone in August, 1944, while a purifier was purged at Rochester in March, 1944, and a new gasholder was purged at Hailsham in March, 1945.

The operation of the machine did not present difficulty at any time, its use for avoiding the presence of explosive mixtures in large vessels being easy, rapid, safe, and advantageous. The purging apparatus was satisfactorily run on gas oil or gas, the volume of inert gases produced being some 10% higher with gas oil than with gas. Additional lengths of flexible hosing for the inert gases were provided, to enable the machine to be operated at a safe distance from gas-works plant. The disposal of the large volume of cooling water needed necessitates adequate pumping facilities on the site. The machine overturned on an ice-bound hill when returning from its first operation at Deal, following which the hand-operated brakes fitted were replaced with an automatic system. The machine, which weighs 5 tons, could be more rapidly transported over long distances if it were conveyed on a lorry instead of being towed.

At a general meeting of the co-operating undertakings held at the Dudley Hotel, Hove, on July 25, the Accounts and Report of the Committee for the period Dec. 1, 1943, to June 30, 1945, were approved. Mr. J. R. W. Alexander (East Surrey), Mr. W. A. Howie (Maidstone), Mr. S. E. Knowles (Eastbourne), Mr. W. M. Patterson (Brighton), Mr. R. H. Ruthven (Ramsgate), and Mr. R. Vevers Scott (Canterbury) were re-elected to the Committee, which co-opted Mr. G. le B. Diamond (Rochester) and Mr. J. W. Townsend (Tunbridge Wells). Mr. J. S. Liversidge, A.C.A., was reappointed Auditor.

The cessation of hostilities in Europe having removed the risk of damage from enemy action, the co-operating undertakings had to determine if the portable purging machine scheme should be continued for normal purposes, or if it should be terminated. It was considered desirable to gain and make available further experience of the use of the machine, the demand for which should be considerable during the period ahead, when so much plant had to be built, extended, and repaired. It was, therefore, unanimously decided to continue the scheme, and the Tunbridge Wells Gas Company and the Operating Officer intimated they were willing to afford facilities and services as hitherto.

The meeting terminated with a cordial vote of thanks to Mr. Alexander and Mr. Townsend for their services in connexion with the scheme.

# The Gas Industry and the Plastics Industry*

By W. E. De B. DIAMOND, M.A., Ph.D., F.R.I.C., Assoc.Inst.Gas E.,

General Manager, British Plastics Federation, Limited

THE plastics industry may be said to have begun with the discovery by Alexander Parkes in 1865 of celluloid. After some years of patient investigation he found that if nitrocellulose was mixed with camphor and alcohol a hard mass resembling horn resulted; this was the pioneer of the modern celluloid manufactured by the British Xylonite Company. Too often the discoveries of British chemists have been exploited by other countries, but this is one example where the discovery was developed in this country. Moreover, the development has continued, so that in spite of the discovery of many new plastic materials, celluloid still holds its own. In fact, many readers of this Paper may find that the frames of their spectacles are made from artificial horn—*i.e.*, from celluloid. Celluloid is a material that can be softened with heat, but sets hard on cooling, and this can be repeated again and again. It is termed a thermoplastic material.

The next development was the discovery by Dr. Baekeland in 1909 that when phenol reacts with formaldehyde under controlled conditions with the addition of a little ammonia a hard resin is formed. This material was used first as a substitute for shellac in varnish or lacquer, and it was not till 1916 that the first moulding powder was made. This synthetic resin, bakelite, becomes plastic when heated, and if pressure is then applied a chemical change takes place, and the material sets in a rigid form which is not then affected by further application of heat. It is known as a thermosetting plastic.

In celluloid and bakelite, then, are examples of the two broad divisions into which plastics may be divided, namely, thermoplastic and thermosetting plastics.

While this is a useful classification based on certain physical properties, it is not a definition. Plastic materials may perhaps best be defined as comprising complex chemical compounds of high molecular weight whose molecules, while stable at room temperature, are plastic at some stage in their manufacture and whose form can be changed under the influence of heat and pressure. Plastic materials may also be classified or grouped in various ways. Two methods are here given to illustrate certain points of interest.

In the table below the more important plastic materials are classified by type. The synthetic group are usually called synthetic resins or resinoids, while the plastics derived from cellulose are usually called cellulosic plastics.

| Natural. | Semi-Synthetic. | Synthetic. |
|---|---|---|
| Shellac ... | Casein } Protein Resins | Phenol- and Cresol-formaldehyde |
| Bitumen ... | Steadin } | |
| | Cellulose derivatives: | |
| | Cellulose nitrate ... | Urea-formaldehyde. |
| | Cellulose acetate ... | Aniline-formaldehyde. |
| | Cellulose butyrate ... | Melamine-formaldehyde. |
| | Cellulose acetate-butyrate | Glycerol-phthalic anhydride. |
| | Benzyl cellulose ... | Polyamides—*e.g.*, Nylon. |
| | Ethyl cellulose ... | Vinyl derivatives: |
| | Methyl cellulose ... | Polyvinyl acetate. |
| | | Polyvinyl chloride. |
| | | Polyvinyl chloride-acetate. |
| | | Polyvinyl acetatals: |
| | | Polyvinyl formal. |
| | | Polyvinyl acetal. |
| | | Polyvinyl butyral. |
| | | Polystyrene. |
| | | Polyethylene. |
| | | Polyvinylidene chloride. |
| | | Acrylic esters. |

Of the natural resins, shellac is still used for gramophone records as well as in varnishes and lacquers, while bitumen is still used for making bottle stoppers.

Of the synthetic resin or resinoids, phenol- and cresol-formaldehydes, urea-formaldehyde and aniline-formaldehyde are thermosetting.

Melamine can be thermosetting or thermoplastic. The others are thermoplastic, except casein, which comes between the two but behaves more like a thermosetting than a thermoplastic type.

An alternative classification is based on chemical constitution as follows:

Cellulosic—*e.g.*, cellulose nitrate, acetate, butyrate, etc.
Phenolic plastics, including the cresylic, xylenol, and aniline plastics.
Amino plastics, including urea-formaldehyde and melamine formaldehyde plastics.
Alkyds formed by reaction between polyhydric alcohols and polybasic acids.
Ethenoid plastics based on the ethylene linkage and including acrylic esters—*e.g.*, polymethyl methacrylate, vinyls, styrenes, polyethylene.
Polyamides—Nylon.

All these plastic materials have large molecules and form long chains. This may take place by polymerization linking up the monomer to form the polymer or, as in the cellulosic plastics, one starts with the long-chain cellulose molecules.

These linkages affect the behaviour of the plastic materials. Consider an ordinary molecule. On the application of heat the vibration of the molecule increases until finally the substance melts. When heat is applied to a polymer, owing to the forces linking the molecules together the vibration increases more slowly, but as it increases the molecules begin to slide one over the other, or in other words, the polymer begins to stretch.

Now in addition to attraction between the atoms due to valency, the molecules are linked together by secondary electrical forces and van der Waals' forces, and there are further cross-linkages between the molecules which, according to the degree of their complexity, may be described by a netting index. It is not appropriate to go further into this matter here, but it may be said that some degree of correlation has been shown to exist between the netting index and the behaviour of the polymer.

If a non-volatile solvent is added to a polymer, it becomes attached to the side chains and absorbed into the molecule. Such a solvent will act as an internal lubricant so that when heat is applied the molecules will slide more easily the one over the other, which will allow stretching or flow to take place. This type of solvent is called a plasticizer, and plasticized plastics can, when heat is applied, thus be made to take the shape of the mould or other form into which it is caused to flow. On cooling the polymer becomes stable and retains the new shape which it has been made to take.

It is stated above that long chains have been formed by polymerization; that is, the combination of a number of molecules to form a single molecule. The degree of polymerization can be controlled by the particular form of the process adopted in manufacture.

With thermosetting materials the polymerization to form a single molecule follows a different course. A condensation takes place with the splitting-off of water.

Linkage goes on developing to form a structure like a network, so that if the heating is carried far enough there is such a complete network that the material becomes rigid or set.

In the manufacture of phenol-formaldehyde moulding powders the reaction is carefully controlled by limiting the amount of formaldehyde and adding a small amount of ammonia, the water is driven off and a resin of a thermoplastic type is formed. Pigments and fillers, such as woodflour, are then added, and the further amount of formaldehyde to complete the reaction to the infusible stage is provided by the addition of hexamethylene tetramine (hexamine or hexa).

This brief description of the manufacture of phenol-formaldehyde moulding powder has been given to explain how it is that this infusible thermosetting resin can be used to produce moulded plastic articles.

It is perhaps not out of place to refer to a statement made in 1929 by the late Prof. H. E. Armstrong*: "Some day probably we shall be forced to admit that coal for the most part is but a natural bakelite."

If one traces the succession—cellulose→peat→brown coals and lignites→bituminous coals→anthracites→graphites—there is a good deal of evidence† to show that in the formation of coal polymerization has taken place (thus bituminous coal is probably a polymer of monomers of moderate molecular weight), not unlike that which takes place in the formation of phenol-formaldehyde resin; water has been eliminated and cross-linkages have been formed to such an extent that the result is a thermostat material.

A final note must be added on polymerization. By controlling the degree of polymerization and the amount of plasticizer used, great variation in the properties of the plastic material may be obtained. One may give, as an illustration, polyvinyl chloride, which may take the form of thin flexible sheet material which can be used as curtains or to make a tobacco pouch; in another form it may be extruded to form an insulating sleeve round wires and cables; it can be woven like a textile or made in thick sheets, in a variety of colours, which may have been seen in use as flooring in the Kitchen Planning Exhibition held at Dorland Hall in February, 1945.

Synthetic resins are the basis of the plastics industry, and though their uses are many and varied, for the purpose of this Paper they may be divided into the following classes:

(i) Adhesives.
(ii) Moulding powders and extrusion compounds.
(iii) Impregnation of paper, fabric, wood and other materials to form laminated sheet.
(iv) Thermoplastic sheet, rod and tubes.

The structure of the British plastics industry is organized accordingly. The plastics material manufacturers make the synthetic resins and the adhesives, the moulding powder and extrusion compounds, the

*L.G.E. Comm. No. 282, Presented at the Annual Meeting of the Institution, June 12–13.

* *Chem. and Ind.*, 1929, **48**, 760.
† Megson, N. J. L., and Pepper, K. W., *Chem. and Ind.*, 1940, **59**, 247.

impregnating resins and the thermoplastic sheet, rod and tubes, and also resins for varnishes and lacquers. The moulders manufacture the mouldings from the moulding powders. The laminated material manufacturers manufacture the laminated sheet, rod and tubes, while the fabricating branch of the industry manipulates and fabricates both thermosetting and thermoplastic sheets.

The labour force employed in the plastics industry is not large, being about 30,000, but its importance cannot be measured by numbers only since the products of the industry are used by so many other industries.

In the early stages of development of the industry plastic materials were usually regarded as substitute materials, but now it is more true to say that they provide a series of new materials for the use of industry. One may illustrate this by an analogy with the iron and steel industry, where the alloy steels provide a series of materials for the use of other industries.

There is not space here to describe the war effort of the Industry, even if security reasons permitted, but the dependence of communications on plastics may be illustrated by their use in radio, radar equipment, aircraft, the desk telephone, while the segments on the automatic exchange are also made of plastics.

## Basic Raw Materials

It is sometimes said that plastics are made from coal, air, limestone and water. This is broadly true, but while a large number of plastics can be made from coal, it does not necessarily mean that this is the most economic method of production. For example, take the manufacture of calcium carbide from coal and limestone for the production of acetylene in this country, where at present there is no cheap source of power, for the manufacture of styrene. Compare this with the production of styrene in America as a by-product of the synthetic rubber industry.

Leaving aside the question of economics for the time being, the following is a list of the materials obtained from coal distillation, including some further materials which might perhaps be obtained:

Phenol with cresol and xylenol.
Benzene—synthetic phenol.
Methane—methanol—formaldehyde.
Carbon dioxide and ammonia—urea.
Ethylene.
Naphthalene—phthalic anhydride and phthalic esters.
Coumarone indene.

These materials will now be considered separately, with particular reference to the Gas Industry's part in providing them.

### *Phenol and Cresol.*

An approximate estimate shows that, on carbonization, 1,000 tons of coal give 60 tons of tar, from which 300 lb. of phenol and 1,570 lb. of cresol are obtained. From the 38 million tons of coal carbonized per year it should therefore be possible to obtain 5,000 tons of phenol and 26,600 tons of cresol. In addition it has been stated that the possible production of benzene is 150,000 tons per annum, which could yield 150,000 tons of phenol. Now the consumption of phenol for the plastics industry in 1938 was about 5,600 tons per annum, and one may estimate that in 1942–43 that had increased by about 80%, including synthetic phenol. It would seem, therefore, that there is an adequate market for all the phenol the carbonization industries can provide, while there is also a market for some 5,000 tons of benzene for the production of synthetic phenol.

It is necessary here to refer to the economic position. Phenol from tar is "natural phenol," and sells at the same price in this country as synthetic phenol—*i.e.*, about 9d. per lb. against the 6d. per lb. which is the present price in America. British exporters of phenol-formaldehyde resin moulding powders and mouldings are therefore at a great disadvantage in having to pay this higher price for natural phenols. If the export trade in these materials proves to be adversely affected in competition with the U.S.A. the demand from the Gas Industry for its phenol may be adversely affected. On the other hand, the American position is not at all clear; benzole is being imported into America, and it is difficult to understand how, after payment for the material, freight and other dues, synthetic phenol can be produced and sold at 6d. a lb.

It is only fair to say that, so far as is known at present, the advent of some of the new plastic materials will not oust the older materials.

In addition to the 5,600 tons of phenol, some 2,500 tons of cresols and xylenols were used in 1938: there again a substantial increase in consumption has taken place, probably of the order of 70 to 80%.

### *Benzene.*

In addition to the use of benzene for the production of synthetic phenol, it is also used for the production of a benzyl cellulose. Another outlet is its use for the manufacture of maleic acid by oxidation: maleic acid being one of the polybasic acids used in the production of alkyd resins.

### *Formaldehyde.*

This is required for the manufacture of phenolic resins, including cresylic, xylenol and aniline resins, and for amino resins, that is, urea and melamine resins, both liquid and solid.

In the plastics industry alone, therefore, substantial quantities of formaldehyde are required. This is likely to increase substantially with peace-time production. For example, in addition to the wide uses of phenolic resins for engineering mouldings and standard lines, such as telephones, urea and melamine resins mouldings can be produced in a wide range of colours particularly suitable for domestic use. Further, there is likely to be a considerable increase in the use of adhesives made from these resins for the manufacture of plywood and for the veneering industry. The bond made by synthetic resins is very strong and resistant to weathering and fungus attack. It is the use of urea resins which has made possible the production of the Mosquito aeroplane.

In 1938, 25,000 tons of formaldehyde were produced for all purposes, while by 1942 the production of formaldehyde and hexamine for the plastics industry alone was probably equal to or greater than this figure (unfortunately no precise statistics are available at present).

Formaldehyde is now mainly produced synthetically from methanol. If methane is separated from the gas stream the Gas Industry has the raw material for the production of formaldehyde, by the catalytic decomposition of methanol. The reactions are as follows:*

(1) $CH_3OH + O \rightarrow CH_2O + H_2O + 36{,}800$ g. cal. per g. mol.
(2) $CH_3OH \rightarrow CH_2O + H_2 - 28{,}800$ g. cal. per g. mol.

Originally the reaction was thought to be mainly an oxidation, but more recently it has been found that by careful selection of the catalyst and better control, assisting the dehydrogenation reaction, greater efficiencies of conversion have been obtained.

### *Urea.*

As mentioned above, the urea moulding powder can be produced in a wide variety of pastel shades, and no doubt most people are familiar with Beetle ware, on sale before the war, and with the white cups, saucers and beakers which recently have supplemented the shortage of similar earthenware articles. The raw material for the manufacture of this substance, namely, carbon dioxide and ammonia, is in the gas stream.

There are a number of processes for the manufacture of urea.† This was the first organic compound synthesized, reported by Wöhlem‡ by rearrangement of the molecular structure of ammonium thiocyanate.

In the process developed by I. G. Farbenindustrie (British Patent No. 145060, 1920) a mixture of carbon dioxide and ammonia is heated in an autoclave, resulting in the formation of ammonium carbonate. This is heated for a further time for the formation of urea, the yield being about 40%. In a later development Krase, Gaddy and Clark synthesized urea by heating liquid ammonia and carbon dioxide in an autoclave at about 150°C. and at a pressure of 100 atmospheres, special non-ferrous or other suitably treated metals being used for the autoclave.

Thio-urea is also used in the plastics industry. A certain amount of thio-urea is added to urea for some purposes. The production of thio-urea by Gas Undertakings has already been carried out in America. The process used is to wash the gas containing HCN and ammonia through an aqueous solution of ammonia in which sulphur is suspended. About 95% of the HCN is removed and a 35% solution of ammonium thiocyanate is obtained. The solution is evaporated to the dry crystalline state and then heated at a temperature of 140° to 160°C., when a molecular rearrangement takes place with the formation of urea. In these reactions non-ferrous metal vessels should be used.

### *Ethylene.*

Ethylene is required for the manufacture of polyethylene, while acetylene is required for the manufacture of vinyl and styrene. In fact, if the vinyl can be built up from ethylene as well as from acetylene —and the following structure indicates that polyethylene is a vinyl structure when R is replaced by hydrogen—then there is an additional possible use for ethylene.

$$-CH_2-\underset{R}{CH}-CH_2-\underset{R}{CH}-CH_2-\underset{R}{CH}-$$

H. Levinstein has stated that some progress has been made in the synthesis of acetylene from methane§: acetylene can also be obtained from ethylene, one way being to make ethanol from ethylene and acetylene from ethanol. Taking an average content of 2% of ethylene in coal gas, then if it were all recovered there would be a potential production of 200,000 tons from the Gas Industry and 200,000 tons from the coke oven industry, making a gross potential production of 400,000 tons of ethylene per annum from the carbonizing industries.

What the possible demands of the plastics industry will be for ethylene for the production of polythene and vinyl and styrene resins it is impossible to say at the present time.

Polythene, which has very fine insulating properties, was just being brought into production in 1938, and its production now is 2,000 times what it was in 1938. It is an all-British plastic material discovered in the laboratories of Imperial Chemical Industries, Limited. It will undoubtedly have many potential uses in the post-war period.

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* Homer, H. W., *J.S.C.I.*, 1941, **60**, 213.
† *Vide* Ellis, Carleton, "The Chemistry of Synthetic Resins," Vol. I, p. 566; Ethylene British Plastics, 1934, V, 550.
‡ *Pogg. Ann.*, 1928, **12**, 253.
§ *Chem. and Ind.*, 1944, March 18, p. 111.

Similarly polyvinyl chloride has been manufactured here on an increasing scale during the war years, and its many potential uses, as indicated earlier in this Paper, will undoubtedly lead to increased production.

Polystyrene has only been manufactured here on a limited scale. It is an excellent injection moulding composition, and its use for this purpose will increase.

While one cannot give possible demands for ethylene, enough has perhaps been said to indicate that it should be well worth while for the Gas Industry to investigate the possibility of separating ethylene from the gas stream. Whether it will be an economic proposition is a matter for consideration, bearing in mind the present cost of producing acetylene from calcium carbide with coal at its present price.

Ethylene glycol is also commonly used as a polyhydric alcohol in the manufacture of alkyd resins.

*Phthalic Anhydride.*

This is required for use as a plasticizer and as a polybasic acid for the manufacture of alkyd resins. Esters of phthalic anhydride are the best plasticizers for cellulose acetate and polyvinyl chloride, while phthalic anhydride is the most commonly used polybasic acid for the manufacture of alkyd resins used extensively in the paint and varnish trade.

Phthalic anhydride is prepared by the oxidation of naphthalene. Sulphuric acid was formerly used for this purpose, but the more modern method is to use an oxide of a rare earth metal as a catalyst to bring about the combination of naphthalene with the oxygen of the air. The reaction temperature is about 250°C.

*Coumarone Indene Resins.*

These resins have not been extensively manufactured in this country but they have been largely used in the U.S.A. They can be recovered from the light tar oils by fractional distillation, coumarone (b.p., 172°C.) coming over between 168° and 175°C., while indene (b.p., 182°C.) comes off at 172° to 182°C. These resins are used as binders and as a minor addition to phenol-formaldehyde moulding powder, where the addition improves the water resistance. They are used in paints and varnishes.

Finally, gas is used extensively for heating the platens of hydraulic moulding presses. There is, however, some need to improve thermostatic control of the burners. Gas is also used for preheating moulding powders, and at the present time the British Plastics Federation, through one of its technical committees, is co-operating with Mr. W. Dieterichs in developing an improved design of preheating oven.

It will thus be seen that by-products of coal distillation can provide a large number of raw materials for the manufacture of synthetic resin. In fact, it has been estimated that 95% of the plastics made in this country are derived from by-products of the carbonizing industries.

In addition the plastics industry is quite a large consumer of gas.

## Plastics in the Gas Industry

What the plastics industry can offer to the Gas Industry is more difficult to say. One disadvantage is that most plastic materials do not withstand high temperatures.

Consider first the manufacturing or works side of the Gas Industry.

In the retort house corrugated polymethyl methacrylate sheet might be used in place of glass in the roof.

Parts of pumps dealing with corrosive liquids might be made of plastics, and laminated sheet material could be used for gear wheels and pump housings.

Polyvinyl chloride sheet material is very resistant to abrasion and might possibly be used for coke screens and for conveyor belting, while improved wood impregnated with synthetic resin might prove satisfactory for use in coke chutes. There are in addition, of course, general industrial applications such as in canteens and so on.

So far as general maintenance is concerned, synthetic coatings and varnishes might well be tried, particularly for water-sealed gasholders. Now for the distributive side.

First there is the possibility of using polyvinyl chloride sheet in place of meter leathers. It is flexible and incorrodible. It is now being tested by the Meters Committee of The Institution of Gas Engineers.

Service pipes could be wrapped in celluloid or cellulose acetate like the handrails of London's 'buses. It would not be cheap, but might be worth doing in specially corrosive soils. The joints could be wrapped with a plastic film and sealed with a plastic cement. Flexible armoured tubing can be made with polyvinyl chloride extrusion compound extruded internally and externally over the armouring.

The handles of the doors and taps of cookers are already made of black phenolic resin—bakelite. Melamine resins could be used and the handles moulded in pastel shade colours. Sides and panels of doors might be made with urea-faced laminated sheet with good heat-insulating material inside. It can withstand temperatures of the order of 170°F. and can be easily cleaned. The same applies to refrigerator panels. Trays for use in refrigerators can be, and were pre-war, made of transparent polymethyl methacrylate and polystyrene plastics.

With regard to fittings, gas-fire surrounds might be made of moulded plastics. They are already used successfully for electric fire surrounds. Alternatively, stoving enamels made from alkyd resins can be used for metal surrounds.

The difficulty of keeping cookers, refrigerators, fires and other fittings in "new" condition is well known to all distribution superintendents. It might well pay to wrap these in the transparent plastic films now used for wrapping war stores. The material usually employed for this purpose, polyvinylidene chloride, is not at present being made in this country but it should be available in the future

With regard to lighting fittings, plastic shades should be a possibility, as mentioned above, and blocks for wall fittings can be made in plastics, in colours if desired, in place of wood blocks.

Hotel bedroom meters are notoriously ugly. Why not house them in an up-to-date moulded plastics container?

No doubt many gas undertakings will be considering the modernizing or repairing of old or damaged showrooms when building licences and labour become available. Here the plastics industry can offer laminated plastic sheets in colour for panelling the walls, and for counter and table tops. The latter might have a Mr. Therm *motif* permanently included in the finish. A vinyl-treated cloth can be offered for upholstery; it is hard-wearing and easy to clean. Splash backs behind water heaters in the showroom might be made of laminated sheet with a tile *motif*, or alternatively in clear, translucent or opaque-coloured methyl-methacrylate sheet.

If electric lighting is used, special shades can be fabricated to architects' designs.

The demonstration theatre offers similar uses for plastics with, in addition, a plastic table top for the working kitchen table. The rubber-like polyvinyl-chloride sheet in colour might be used as a floor covering. It is hard wearing and would deaden the noise of people entering and leaving.

So far as advertising is concerned, novelties in great variety could be provided, such as Mr. Therm ashtrays. If a moulding is to be made, 5,000 to 10,000 would be a minimum economic quantity: runs of 500,000 to a million give a better return for the outlay on the tools

If quantities less than 5,000 are required these can sometimes be produced by fabricating.

In putting forward some suggestions for the use of plastics by the Gas Industry economic questions have been ignored, while others may be ruled out on technical grounds, but perhaps they will provide food for thought concerning these new materials for the use of industry —plastics.

# Gas Undertakings' Results

**Boston Gas Light and Coke Company.**—The revenue account shows a net profit of £590, a decrease from last year of £1,169, due mainly to the increase in the price of coal. Sales of gas during the year showed an increase of 85,762 therms, or 8.1% compared with 1941. Revenue from residuals showed an increase of £7,397. The demand for gas continued to grow, and gas cookers, boilers and refrigerators are to be installed in the prefabricated houses allocated to Boston. A final dividend has been declared of £5 2s.% on the old £10 shares, making £10 4s.% for the year; and on the new £10 shares of £4 4s.%, making £8 8s.%.

**Hawick Gas Company.**—It was announced at the annual meeting that for the past year the output of gas was 164,720,300 cu.ft., which was an increase of over a million cu.ft. over the previous year. The year's profit was £1,830, and the dividend has been fixed at 4% free of tax. No major work was undertaken during the year, but all necessary maintenance and repair work was executed. Since the Ministry of Fuel and Power authorized an advance of 5d. per 1,000 cu.ft. both wages and the prices of coal have gone up, but the Directors are confident that if the sales of gas continue to increase, and the by-product business is favourable, it may not be necessary to impose a further increase on the price of gas.

**Kirkaldy.**—The Gas Department reports a loss of £233 on the year's working. From sales of gas the income totalled £68,409, representing 365 million cu.ft., a record for the undertaking, and £30,669 was realized from the sale of coke, tar and benzole, including £13,265 as the value of coke used on the works. The aggregate fuel cost was £53,086 against £44,929 last year.

**Montrose Gas Company.**—The report for the year ended June 30 intimates that the quantity of gas manufactured was 142,990,000 cu.ft., being an increase on the previous year. After deducting the usual depreciations, the accounts show a profit of £2,701 from the previous year, making a total of £9,092. It is proposed to carry £1,000 to contingency fund, and to pay a final dividend of 4½%, making 8½% for the year, plus a bonus of 4d. per share, requiring £2,958, and leaving £3,009 to be carried forward, subject to directors' remuneration.

**St. Helens.**—The annual report of the St. Helens Gas Undertaking for the year ended March 31 includes the following information: The gas made was 1,675,238,000 cu.ft. as against 1,099,827,000 cu.ft. in 1940 and 1,753,758,900 cu.ft. in 1944. The coal carbonized was 100,619 tons. By-products made included 53,477 tons of coke, 6,843 tons of tar, and 247,882 gall. of benzole and naphtha. The number of consumers is 26,975, and the gas is supplied over a network of 212 miles of main. From the net profit of £40,852 various capital charges were met and a satisfactory balance was added to the reserves of the Undertaking. In spite of the increased cost of coal, there is no increase in the price of gas.

# The Gas Industry and the Balloon Barrage

**Discussion on the Paper by W. K. Hutchison, B.A., B.Sc., M.Inst.GasE., A.M.I.Chem.E. (Director of Compressed Gases, Air Ministry), at the Annual Meeting of the Institution of Gas Engineers.**

Mr. **Hutchinson,** introducing the Paper, explained that the first hydrogen plant at a gas-works was completed and put to work in July, 1940, and by the spring of 1942 the position was reasonably secure. Hydrogen could be supplied in any area where deployment of balloons was likely to occur, from factories near enough to give the supply without making too heavy a drain on cylinders and transport facilities. It then became possible to pay rather more attention to questions of technical efficiency and cost of production. He paid tribute to the assistance he received at all times from the engineers and the staffs at the 19 gas-works at which plants were installed.

## An Important Advance

Dr. **J. G. King** (Director, Gas Research Board): In the early days of the balloon barrage it was my privilege, with certain colleagues at the Fuel Research Station, to give some help to the solution of the early difficulties which always beset new schemes. Although much was known then of the Lans process of hydrogen manufacture, the knowledge was available only in very few places when the need for a balloon barrage became evident. Further, the information related mainly to plants suffering from the severe handicap of employing mild steel reaction vessels in which the temperature of operation, and therefore the output, were limited by considerations of the resistance of the metal to the conditions imposed. The work which Mr. Hutchison has described, of building up from this modest nucleus to the scale of 19 producing plants having a potential output of 25 million cu.ft. of hydrogen per week, is an achievement of which he and his staff and the gas engineers who have helped him can justly be proud.

Perhaps the first important advance was the change from metal reaction vessels to firebrick generators—a move which allowed of the use of a higher reaction temperature and greater rates of production, but which was complicated by the necessity for avoiding undue loss of hydrogen. As Mr. Hutchison has explained in his description of the process, the control of the reactions was a very important factor in which a careful choice had to be made, so that sufficient continuity of operation could be achieved and the hydrogen produced at minimum cost.

In his theoretical section Mr. Hutchison has explained how the reducing reactions must be balanced against those of hydrogen production in such a way that an economic balance is maintained between consumption of water gas on the one hand and consumption of steam on the other. I might add to this the practical consideration that in the early work at the Fuel Research Station we found it expedient to examine the course of the reducing reactions, and then to build upon a suitably controlled reduction the secondary stage of oxidation of the reduced iron with steam. Although the extent of reduction is influenced by the equilibria of the reducing reactions, it is apparent that the practical limitation is imposed, not by the equilibrium, but by the rate of reaction; since, as the reduction proceeds, the rate of reaction falls off, it follows that there is some practical point during reduction at which it is expedient to interrupt the cycle.

The Author has pointed out the difference between the reducing reactions (*a*) from $Fe_3O_4$ to FeO and (*b*) from FeO to Fe; but we did find at the Fuel Research Station that the practical point of interruption occurred at a time when some small amount of free iron was present as well as FeO.

It will also be apparent that the time taken to reach this practical point of interruption must be influenced by the amount of surface of ore exposed, and, therefore, by the size of the ore. In the early work, broken ore up to 2 in. in size was used, but in later work it became possible to use a smaller ore under conditions of greater control. It was then found that the quantity of reducing gas required per unit of hydrogen used was appreciably less, and appreciably nearer the theoretical requirements corresponding to the reaction temperature used.

It is interesting to record that after some experience of the manufacture of hydrogen in brick-lined generators there was built at the Fuel Research Station an experimental generator of the Messerschmidt type embodying many of the new ideas which had emerged, ideas relating to temperature control, heat interchange, and pre-heating of the reacting gases. By suitable heat interchange and pre-heat it was possible to maintain this generator in efficient operation even while the output varied from 4,000 to 7,000 cu.ft. of hydrogen per hour. This flexibility of operation had considerable practical value, in view of the variability of demand and the difficulties associated with lack of storage capacity and the irregularity of supply of cylinders to be filled.

## Meeting the Demand

Mr. **R. C. Taylor** (Torquay): The importance of the generation of hydrogen in connexion with the future production of methane cannot be overlooked. Nor can we overlook the important experience we have obtained in the compression of gases to pressures of over 3,000 lb. per sq.in., particularly as the plant utilized for this purpose has on occasions been subjected to long periods of overloading to meet unpredictable conditions dictated by intense enemy activity. We in the Gas Industry—and here I speak more particularly for those six undertakings in the south—did all within our power to provide, in the initial stages, all the plant we could spare, and such facilities as we could afford through the difficult years of operation. It is not without feeling that we enhanced the value of already vulnerable targets. The problem of supplying hydrogen under emergency conditions did not result in a panic-stricken attempt to produce the gas without due control of costs and efficiency of operation. Indeed, on the contrary, from the outset the Directorate had a clear conception of its requirements. The basis of costing and the initial formula for the computation of water gas and steam costs, &c., displayed a clear insight into the economics of the problem. It provided reasonable operating conditions for the undertaking concerned—conditions not easy to assess, for, as Mr. Hutchison has pointed out, there was a great divergency in the types of agreement, depending on factors which were peculiar to each separate undertaking. Operational efficiencies were carefully and methodically stimulated by routine technical reports, and the technical information thus derived we are now privileged to have among our Institution records.

Speaking for the six undertakings interested in the production of hydrogen in the south, I feel that some mention should be made of the advance work carried out at Bournemouth. Bournemouth and Torquay bore the brunt of the load on D day; I am pleased to say that the load was not so heavy as we had feared, in view of the complete success of the operation. The four remaining undertakings—Weston, Epsom, Swindon, and High Wycombe—were able to take their full part in the provision of the hydrogen for the barrage against the flying bomb attacks, their geographical dispositions easing transport difficulties. Altogether the six undertakings mentioned supplied over 800,000 million cu.ft. of hydrogen to the balloon barrage, and the fact that we never failed on any occasion to meet the demands created by enemy action, storm, and lightning is due largely to the happy relationship which existed between the Director and we of the Gas Industry.

## Experience at Bournemouth

Mr. **W. F. Thorne** (Bournemouth Gas and Water Company): We at Bournemouth are particularly interested because ours was one of the earliest plants to produce hydrogen for Balloon Command. The plant started up in October, 1940, and since that time has made about one-seventh of the total hydrogen supplied by the Gas Industry. The early days were somewhat chaotic because the Bournemouth plant was the first of its particular type, and little practical data were available regarding its operation. The greatest difficulty, and one which persisted throughout the war, was the erratic demand for hydrogen. In the course of 24 hours the demand might change from nothing at all to 100% load. That could be partly accommodated by the storage holder and partly by the flexibility of output of the generators, each of whose production could be varied from 5,000 to 11,000 cu.ft. per hour. Initially the supply of contact material was restricted, and the generators were worked at a relatively low temperature so as to give the maximum life of iron ore. Subsequently the ore supply position improved and fuel economy became of more importance. These factors caused a modification of the method of working so as to achieve a lower ratio of water gas used to hydrogen made, at the expense of a shorter ore life.

I was particularly interested in Mr. Hutchison's remarks about the reaction proceeding in two well-defined stages. At Bournemouth we put a gas flow recorder on the hydrogen flow from each generator and observed two distinct peaks in the rate of hydrogen production during a given cycle. The first of these peaks was considerably greater than the second, and it was found that by reducing the rate of steam flow the first peak could be reduced and the second intensified until they were both of the same magnitude. Under those conditions the lowest water gas/hydrogen ratio occurred, and this method was used subsequently for routine control.

The original method of hydrogen sulphide removal at Bournemouth was by normal oxide purification. Pure oxygen was added to the hydrogen in theoretical amounts, but purification was found to be very difficult and somewhat erratic, and it was not easy to achieve the standard of purity required. The liquid purification process which Mr. Hutchison has described is completely reliable, and came as a very welcome relief from oxide purification. It is important to note that complete $H_2S$ removal by alkali is only possible if the whole of the $CO_2$ is removed either simultaneously or previously.

Mr. **J. Hunter Rioch** (Cambridge): The Cambridge University and Town Gas Light Company was one of the first undertakings privileged to assist the Air Ministry in the provision of hydrogen for the balloon barrage. Our installation was one of the early plants of the "annular" type built by Messrs. Humphreys & Glasgow. We were unable to accommodate the compressing station on our own works; therefore an adjacent site, formerly used as a refuse dump and belonging to the Cambridge Corporation, was requisitioned, and hydrogen was delivered from the storage holder on our works—a distance of about 300 yards—to compressors on the requisitioned site. The nature of the ground through which the delivery main had to pass necessitated supporting it for a considerable part of its length on timber piles, and no trouble whatever from leakage has ever been experienced. The joints employed were of the Stanton screwed gland type.

Secondly, the Cambridge plant was the only one in the country in which backrun gas was drawn from a plant making carburetted gas. During most of the year we require fairly heavily carburetted water gas for our own purposes and, since it was necessary to avoid the risk of contaminating the iron ore by hydrocarbons carried forward in the carburetted gas, and in order to avoid purging the hydrocarbons from the plant on each occasion before supplying blue water gas to the Air Ministry, a special connexion was inserted in the backrun main between the generator and washbox on the water gas plant. A valve on this main opened and closed automatically with operation of the backrun lever. An adjustable butterfly valve controlled the rate of supply to the hydrogen plant, and the requisite quantity of backrun gas was led through a condenser scrubber fitted with a safety seal to the crude blue water gas holder supply on the hydrogen plant.

The ratio of blue water gas to hydrogen obtained on our plant in the ordinary course of running gave monthly figures as low as 1.51, and there is no doubt but that in obtaining these low figures we were assisted by the careful use of the purging holder.

I would emphasize the great improvement in efficiency which resulted from the close grading of the ore in the range ¾ in. to 1½ in., giving maximum superficial area of contact material, while avoiding premature failure of the generator due to back-pressure set up by the disintegration of the ore. The factors of superficial area of contact material and resistance to flow of gases are contrary, and it was experimentally determined at Cambridge that the aforementioned range was the best practical compromise. Appearance and porosity of the ore are also important, and great care was taken in the selection and sizing before filling the generators. In practice up to 10% of the material was rejected.

Our plant has been characterized by its flexibility, and when high outputs were demanded its performance was indeed remarkable. Whether the rate of production has been high or low, no difficulty in control has been experienced. During the flying bomb menace last year two generator units were operated together with ancillary plant designed only for one, and the output reached approximately 2½ times the rated capacity without any difficulty; hourly outputs of the order of 17,000 cu.ft. of hydrogen were obtained.

As a guarantee against continuity of B.W.G. production the Air Ministry provided a transportable B.W.G. plant which was first erected and tested on our works. This plant, to which reference has already been made in the Technical Press, was entirely independent of external steam and power supply; it had a nominal capacity of 300,000 cu.ft. per day; and it proved entirely satisfactory when tested on gas and furnace cokes.

Mr. **George Evetts**: I should like to stress the importance of the contribution which the Gas Industry made to one phase of war activity. Having had the privilege of working under Lord Ridley, the first Director of Hydrogen Production, and later under Mr. Hutchison, I can vouch for the very able manner in which all the technical problems were solved, with the willing co-operation of the Gas Research Board and the gas engineers. Not only did they come willingly to our assistance, but within a very short time they were really and truly active. We are justified in claiming this venture a success, because in the result the production never fell short of requirements. Whether we were asked to supply the R.A.F., the Ministry of Supply, the Ministry of Aircraft Production, or any other Government Department or even private persons, the supplies were always forthcoming. The rapid concentration of the balloon barrage in south-east England during the flying bomb attacks did for a time put a strain on our resources, but the initial strategic plan was equal to this unforeseen emergency.

Mr. **Robert Fife** (Kilmarnock): The Kilmarnock plant was the third to go into production in a gas-works in Britain, and had a rated output of 2½ million cu.ft. of hydrogen per week. Production was continued from December, 1940, until July, 1944. From the start the plant responded quickly to our needs, which averaged 1¼ million cu.ft. of gas per week for the first 18 months, reaching peaks following the Clydebank and Greenock air raids. No serious difficulties were encountered in meeting the varying requirements of Balloon Command, as the hydrogen generating units were found to have a wide flexibility in their range of output. Simple adjustments of water gas, steam, and air rates provided a range of from 4,000 to 8,500 cu.ft. of hydrogen per hour per generator, with reduced efficiencies when pressing for the higher figures. With three hydrogen generators our peak output reached 2¾ million cu.ft. in one week, and this was accomplished with a comfortable reserve in hand. The gas manufactured at Kilmarnock was supplied to the barrages on the rivers Forth and Clyde and to the Belfast area. The difficulty in the storage of hydrogen might indicate a possible advantage in the use of a welded type of gasholder.

The Author has drawn attention to the installation of water sprinklers as a safeguard against fire in the cylinder-filling bays. The advantage of the application of this protective measure was illustrated on one occasion when, through a momentary lapse, an attendant uncoupled a connecting hose at a time when the gas pressure was at 3,200 lb. per sq.in. The quick emission of the high-pressure hydrogen ignited the gas and the flames spread to several other small leakages, which at this stage, with the well-worn hose couplings, were unavoidable. The quick application of the sprinkler water kept the cylinders cool and prevented the fire spreading to the rubber coating of the hoses, but it needed a high pressure jet of water directly applied from a fire hose to extinguish the flames completely. From this experience I would recommend, in addition to the installation of the sprinkler apparatus, that a suitably placed hydrant with a convenient length of fire hose should form part of the fire-fighting equipment.

The compressors at Kilmarnock were each capable of delivering 6,000 cu.ft. of gas per hour at a pressure of 3,000 lb. per sq.in. We were equipped with four such compressors driven by direct-coupled 120 h.p. gas engines. Careful and continuous maintenance on those units was amply repaid by their rendering of trouble-free service. The most disturbing problem in connexion both with the engines and the compressors was an abnormally active corrosion in the water jackets of the cylinders. The cooling units for the water consisted, in the case of the gas engines, of an open type of radiator where the water percolated through a meshwork of filling material, and was cooled by a strong air blast induced in a lateral direction by an electric fan. The cooling system for the compressor water was somewhat similar, except that the water flowed over louvres and was met by an upward current of air. Here were circumstances in which the water was being constantly aerated—a state of affairs which must have accelerated corrosion.

Chemical treatment of the water by sodium metaphosphate was suggested and tried, but with no apparent effect beyond the removal of some scale, which clogged the flow and return pipes. In my opinion the conditions obtaining with this equipment called for either the addition of a de-aerating unit or for the use of a static water supply, which would have required storage space.

Mr. Thorne has drawn attention to the difficulties encountered in the removal by oxide of the sulphuretted hydrogen from the hydrogen itself. We also spent a considerable time on this problem, but finally reverted to the purification of the gas by caustic soda solution. The original filling in the caustic soda washing towers consisted of a type of unglazed porcelain ring. This material softened and disintegrated in a few months by the action of the caustic soda solution, and was replaced with rings about 1½ in. by 1½ in. fashioned from hoop iron.

## Author's Reply

Mr. **Hutchison**, replying to the discussion, said: We treated the reduction of the ore as a simple two-stage operation, of which, of course, the more difficult stage was occurring where the water gas had the higher reducing capacity. On top of this there would undoubtedly come the velocity effect, whereby the various stages would go in some degree together. When we have more leisure it might be interesting to cool off a generator which has reached the reduced stage, not as we do now with steam, but in its own time in the atmosphere, and analyse the ore at different levels. That suggestion I make to the Fuel Research Station. Mr. Thorne has referred to the difficulty of segregating two stages in the steaming. Flow meters, after all, are not all they might be on hydrogen, due to the fact that any change in temperature affects the specific gravity so much due to the extra water carried in the hydrogen; and at the end of a large capacity consisting of the water gas cooler probably the stages are not so clearly defined as in those special cases which were so well carried out at Epsom, in which we had special sections of the project side by side with the small holders. That is a method which I think is extremely sensitive, and able to detect effects which a flow meter might not be able to detect. I think my theory on this matter is supported by Mr. Thorne's point that there were in fact two peaks. I really cannot explain why there should be a second peak, but the first was definitely much higher than the second, and the smoothing out which occurred when the steaming rate was reduced was rather what one would expect. By reducing the initial steaming rate there was more time for the reaction to take place.

We always looked upon the plant at Cambridge, to which Mr. Hunter Rioch has referred, as one of our great standbys in time of trouble. That plant, with its large holder, represented a very important contribution by the Cambridge Company. The holder gave us the capacity from which almost a week's normal supply could be drawn in two days, with the aid of three compressors. We found that to be of the greatest value, combined with the big reserves of producing capacity, all of which was brought into play when most needed, at the time of the flying bomb attacks.

The Kilmarnock plant, of which Mr. Fife has spoken, was another of those larger plants which took the load in the early days, and took it very well. In fact, in the course of time the diversion of the enemy attack from Scotland to the south enabled the plant to ease off. It had been supported by other plants in that area; but the contribution it made during the early attacks was of the greatest value.

# Production at Gas-Works of Reactive Coke

**Discussion on the Paper by H. D. Greenwood and Dr. J. G. King, and T. F. E. Rhead and E. T. Pickering, at the Annual Meeting of the Institution of Gas Engineers—see "JOURNAL" of July 25.**

Dr. **A. Parker** (Director, Fuel Research Board): Many years ago the Fuel Research Station did work in connexion with transport producers—in the early 20's—but nobody was particularly interested, which I can readily understand, because I think it is true that nobody wants to run a vehicle with a trailer producer or a mobile producer using solid fuel if he can obtain liquid fuel at a reasonable price. Obviously, in this direction, the Gas Industry might do far better by extracting benzole. Nevertheless, there was a problem, and we realized before the war that there are parts of the world where petrol is not easily obtainable and where producers of this kind can be useful.

In the experiments which were intensified in 1937, and further intensified after the outbreak of war, our staff experimented not only with the ordinary private car and the public service vehicle, but with commercial vehicles for the transport of goods, and with tractors for agricultural purposes, and there is no doubt that they can be made to work very well. But there are a number of problems. For example the gas has to be well filtered if there is not to be undue wear of the engine, and the work has involved engine wear tests.

We are considering the production of reactive coke. As mentioned in the Papers, the Coal Survey came in extremely useful because we had all the data ready for making coke and for selecting anthracite. Another point is that this is great team work, and it has clearly shown how apparently purely academic observations years ago have been of real use. It was in the Gas Fellowship work of Prof. Cobb many years ago that the action of sodium carbonate for mixing with coal before carbonization or for impregnating the coke was found to provide a coke with greatly increased reactivity. I do not think that anybody at that time foresaw that it would eventually be used, even if only in an emergency period. It is not easy to get sodium carbonate to stick on the surface of coke or even anthracite, which are very difficult to wet. In the experiments, many tests were made trying the addition of certain agents to the sodium carbonate solution, even adhesives such as starch and sodium silicate, which fill the purpose of what I will call an adhesive. All these problems were tackled and, as Mr. Greenwood has said, we cannot say that the problem is entirely solved. A great deal of work lies ahead.

With regard to future application, we come to a point mentioned by Mr. Rhead which, to my mind, is of great importance, and that is the provision of a reactive fuel suitable for small fuel-burning appliances such as one has in the ordinary house. It may be that this work will develop in such a way that more suitable fuels for domestic appliances can be produced, but let us not at the same time forget the other side of the problem—viz., producing appliances which will burn coke more easily. It is to be hoped that a great deal of work will be done in that direction.

Mr. **C. H. Bamber** (Rochdale): The interest of most of us in this Paper will lie in its contribution to our knowledge of the possibility of producing in the course of more or less normal gas manufacture a highly reactive coke more particularly in high-temperature continuous vertical retorts. Under the heading "Characteristics required in Producer Fuels," the Authors, in detailing these properties, outline also many of the properties required in cokes for use in an open domestic grate, and also to a lesser degree in the many forms of closed stove. High reactivity to provide ease of ignition and high rate of gasification are, I am convinced, equally necessary in a coke for domestic open fires. Most gas cokes, as normally produced, offer difficulty in ignition, and their low reactivity reduces flexibility in control of the heat output of the fire. On the first point, ease of ignition, the gas poker or gas-igniting burner offers only a partial solution and, on the second point, low reactivity means that the fire has to be kept burning at a high rate of heat output, with the result that for most days the room is overheated and uncomfortable. Furthermore, the temperature of the fuel bed is high, and often clinker formation takes place with heavy wear and tear on the firebars and refractories. From personal experience, using for test purposes sample batches of the reactive cokes produced at our works for mobile producers, on firegrates in my own home, I can say that their difference in behaviour from normal high temperature coke is very marked indeed. The cokes produced have been tried on the latest types of open coke fire, and give ease of ignition and controllability far and away beyond that of normal gas cokes. Furthermore, for domestic use it is not necessary to have as close grading of the fuel as is the case with the less reactive cokes. This, I believe, is desirable for two reasons. One, of course, is that the problem of close grading is still waiting to be solved by screen makers, particularly with gas cokes, which are somewhat friable and subject to breakage after screening. The second reason is one on which I feel strongly. While a scientist by profession and training, and accustomed to assessing the value of things by figures and facts, I am a great believer in what I term practical efficiency or effectiveness. This is a property difficult to assess.

Measures of efficiency in the case of a domestic fire do not measure its effectiveness or the pleasure it gives to the occupant of a room. I suggest that a coke fire burning a fuel of low reactivity with a very closely graded fuel and few CO flames on its surface is not half so pleasing to the user as one with irregularly sized fuel, highly reactive, and with lively CO flames flickering on its surface. The longer wavelength of the heat rays also adds to the comfort of this fire. Furthermore, a fire of this latter type will continue to burn down almost completely like a coal fire, while the former needs to be kept burning at a high rate. The fire using highly reactive coke may have a lower thermal efficiency, but it will be more effective, and methods of improving its efficiency should be investigated.

At Rochdale we carried out fairly large scale production of fuel for the Ministry, investigating the problem of coke for mobile producers with a view to assessing the possibilities of its production during normal gas manufacture. Useful quantities were not immediately required for producer work, and I was permitted to use these for experimental work of our own. Householders supplied with this coke were, without exception, enthusiastic in their praise of its qualities. In many cases they had not been aware that they were being supplied with any different fuel from normal. Even in the unscreened state it burned freely on ordinary domestic grates.

We were fortunately situated at Rochdale for the carrying out of these experiments. An installation of Glover-West retorts was in use by the Ministry of Supply Chemical Warfare Department for a large-scale special carbonization process, and the Ministry was able to put retorts at our disposal for the work, and also loaned their new screening plant for the experiments. Their specially equipped laboratory was also available for the carrying out of C.A.B. and potential tar tests at our works.

A further remark on the subject of household coke fires suggests itself to me. Ash content of the coal and subsequent coke is not so vital as the distribution of the ash in the fuel. A coke fire using fuel with as high as 12% ash can be satisfactory so long as the ash is not present in the form of masses or bats. But the makers of coke grates must provide a larger ash receptacle. Echoing an expression from yesterday's meeting concerning the northern part of this country, a coke fire in use in our part of the country may burn continuously for about 16 hours, and the most modern grate of which I know requires the ashpan to be emptied at least three times during that period even with cokes of about 8% ash.

Dr. **F. J. Eaton** (Gas Light and Coke Company): The need for a vehicle producer fuel has vanished, and we are now mainly interested in the possible applications of a coke characterized by having a low C.A.B. value, low bulk density, and which may or may not be treated with sodium carbonate.

The Authors of the first section of the Paper appear to suggest that the lower the C.A.B. value of a coke, the better its performance on an open fire. This statement is only partly true. Over a period of years we have accumulated much data on the performance of different cokes on open fires, one of the cokes tested being from Bullcroft coal, carbonized at Rochdale and mentioned in the Paper. From this data I have tried to relate fire performance to C.A.B. values, but without much success. All that can be said at present is that provided the C.A.B. is below a given value which appears to decrease with increase in bulk density, further lowering of the C.A.B. does not have any marked effect. Thus, for example, the Bullcroft coke having a C.A.B. of 0.042, and bulk density of 20 lb./cu.ft., was no better in an open fire coke grate than a coke made in similar vertical retorts, but using different coals having a C.A.B. of 0.06, and a bulk density of 22.4 lb./cu.ft. I should mention here that in assessing fire performance, we take into account the ignitability of the coke, appearance of the fire, whether it has flames or not, and the period of burning fixed by the number of hours the radiation heat output exceeds 5,000 B.Th.U./hour. It is probable, however, that lower C.A.B. values are required for different appliances. This is proved by the experience at Liverpool with Dryco where, for a stool bottom grate, C.A.B. values of less than 0.05 appear to be necessary. I feel, however, it would be wrong to devote much attention to providing a special fuel only for existing coal grates, especially as in the new housing programme more interest is being taken in grates capable of burning all solid fuels.

Coming now to the performance of an alkali activated coke on the open fire, if the alkali content is above 1% there is a big improvement in ignitability, and the appearance of the fire over the first hour could hardly be bettered. Soon, however, the fuel becomes coated with a white ash, difficult to remove by raking, which gives the fire a very dirty appearance. After the first hour, too, the beneficial effect of the alkali appears to have worn off. Reducing the alkali content to 0.5% does not help the appearance of the fire materially and has an adverse effect on ignition.

The domestic boiler appears to me to be a more suitable appliance for the low C.A.B. cokes. Here improvement is desirable in two directions; first, it would be helpful in meeting seasonal fluctuations in

demand to be able to get combustion rates of less than half a pound per hour, and, secondly, it would be convenient if a large size of coke could be supplied for these small boilers. Our experience with the vehicle producer shows that cokes with a lower C.A.B. value than 0.05 are necessary under short delivery conditions when the temperature of the fuel bed is low. Under medium and long distance delivery conditions, low C.A.B. values are not so essential, and it has been recorded in the Paper that satisfactory results have been obtained on a wet blast producer with a coke of 0.06 C.A.B. Short distance delivery conditions are very similar to banking in a small boiler, and it is therefore fairly certain that a lowering of this banking combustion rate would follow the reduction in C.A.B. The use of larger sizes of coke in small domestic boilers or in openable stoves is important since only about 15% of saleable coke, excluding breeze, is of boiler nut size, and further supplies of suitable domestic boiler fuel can at present only be made by cutting. Activation and lower C.A.B. cokes form an attractive alternative to cutting. The vehicle producer experiments have shown that wider range anthracites were made suitable by activation, and it is possible that the same effect may apply to cokes.

Dr. **J. G. King** (Director of the Gas Research Board): There are lessons to be learned from the work which could be applied in other directions in the Gas Industry, and reference has been made to this by practically all the speakers. When starting the investigation, use was made of the existing knowledge, as Dr. Parker has said, on the properties of British coals as shown by the results of the detailed coal surveys, and secondly of the effect of conditions of carbonization upon British coals of different types, and particularly in relation to the influence of the type of coal on the reactivity of the coke made. The existence of this knowledge is a great deal to shorten the investigation. The use of the new knowledge which we have acquired during this work should help in other directions. An important direction is obviously that of the production of a reactive coke for other purposes.

The full story of how reactive coke can or should be made has not yet been told. On the fundamental side, some explanation of reactivity is emerging from the work of Riley, but he has not yet been able to give us a full explanation of this curious phenomenon of reactivity. I feel personally that the fundamental observations should be explored in relation to existing coke, and it is my personal opinion, also, that perhaps the best way to tackle the problem is to deal with the coal before it is carbonized. In other words, to treat the coal in some way so that, during the process of carbonization—and an amended process of carbonization is necessary—the Gas Industry can produce a coke which will have the desired properties.

I would now like to make one or two comments on what has been said. I fully endorse Dr. Parker's plea for collaboration. This was an investigation in which very many interests were concerned, and so many people helped that a useful conclusion was reached in the minimum of time. I believe in collaboration all round, and I believe that the Gas Research Board in the future will do its utmost to collaborate with other bodies interested in the same fuel. I may say that I am confident that they, in turn, will do the same for us. Mr. Bamber, who helped so much in the manufacture of these fuels at Rochdale, has put in a special plea for a reactive fuel for the open fire. Again I speak personally, but my feeling is that that is on the right lines. It is not sufficient to make special appliances such as special open fires to burn non-reactive fuels; let us rather make reactive fuels which will burn in any type of grate, and which will have such flexibility that if the consumer has only an open grate he can still make use of it and subscribe to the desire for a smokeless city. To some extent Mr. Bamber is on the same point that I am—viz., that this investigation has turned the limelight of our attention again on reactive coke. In saying this, I must point out that the Gas Research Board are not blind to its implications, and that it is only lack of staff due to war conditions that has prevented our Coke Research Group from being very active in this field.

I agree with Dr. Eaton that in the case of the coke-fired boiler there is ample room for reactive coke. That is a good place to use a sodium carbonated fuel, but for the open fire I should like to apply the sodium in a way that it does not spoil the effect of the fire, or deal with the fuel in some other way to get the same effect.

**Mr. E. T. Pickering:** Obviously we have turned our backs on the mobile producer, but are looking forward, and expecting, that the work done will play its full part in the future. I have been very much heartened in that respect in reading in the Report of a Committee a statement that the closed stove and the hot-water boiler are expected to play a very big part in the heating of the large number of houses that are shortly to be built. Dr. Eaton has mentioned the effect of the use of sodium carbonate on the appearance of a fire. We have done a certain amount of work on this in Birmingham, but not as much as we would have liked by any means, and the results have not all gone one way. I think there is very great scope for investigating the effect of different coals, and it may be that we shall find there are instances where the ash does have an effect, and instances where it does not.

As to the question of whether coke should be made to burn in any grate and to give better performance in existing appliances, or whether special appliances should be made to deal with activated coke as well as other types of coke, I would make this point: I think there is some substance for believing that alkali activation does even-up the combustible properties of cokes made from different coals—*i.e.*, it has more influence, possibly, on the more difficult cokes than on the more reactive cokes. One of the big bugbears of the housewife is that if one tries in the Industry to put forward a very reactive coke, there are times, because of the variation in the types of coal received, when the supply of these cokes cannot be maintained. I am hoping that alkali activation will even out the differences in the types of coal received. If that is so, then it will be a great contribution towards a solution of the problem.

## "Gas Abstracts"

The Institute of Gas Technology, Chicago, has started to issue "Gas Abstracts" of a new phase of service to the Gas Industry. For some time the Library and the technical staff have been co-operating in preparing abstracts of papers appearing in technical journals. "Gas Abstracts" will be prepared by assembling, once each month, abstracts which have been prepared in this manner. A major advantage of the service is that it selects for the attention of the Institute's staff and the technical personnel of member companies those articles which seem to be of immediate interest. This selection will bring pertinent technical information before the Industry while it is current.

The Institute of Gas Technology was established with one of its aims as "the collection and dissemination of scientific information." The collection of scientific information has resulted in the formation of a library which now comprises approximately 5,000 volumes, a large proportion of which is bound periodicals. Well over one hundred scientific journals are received currently.

## C.A.M.A. and Research

Just as we recognize the need and indeed stress the need for the trade associations, said Mr. W. Rennie in his Presidential Address to the Combustion Appliance Makers Association (Solid Fuel), so do we also recognize and stress the need for separate organizations to conduct research in coal utilization. This does not mean that C.A.M.A. is not interested in research, but that its primary function is to ensure that the needs of the appliance manufacturers are met in the formulation of research programmes, and that the results of research are effectively and promptly used. I attach the greatest importance to the work of the Research Committee, the reconstruction of which is being considered by your Council, and which will be responsible for keeping a close watch on all research developments likely to affect appliance-making interests.

Thus, although C.A.M.A. will not directly conduct research work itself, its Research Committee will be charged with the duty of considering the problems of the appliance-making industry as indicated by members, and will study and report on information received from the research organizations, and endeavour to secure that research and investigations by the various bodies should be directed into channels of value to that industry. In the same way, through the C.A.M.A. Research Committee, appliance makers will give valuable assistance, especially in connexion with testing and development of new appliances, to the various research organizations.

## "Cash Balancing" Meter

At the invitation of the Manchester Corporation Gas Department, George Wilson Gas Meters, Ltd., recently held a demonstration in the Gas Theatre at the Town Hall. The gathering numbered over 50, and consisted of engineers and distribution superintendents from the North-West, Yorkshire, and Lincolnshire.

The meeting was opened by a representative of the Corporation Gas Department, following which Mr. W. D. Wilson briefly outlined the origin of the idea, which had enabled the firm to develop a prepayment meter to supply a continuous by-pass to any gas appliance, such as a refrigerator, even when the prepayment valve was closed. He also stressed the difficulty of supplies in these days, and emphasized that any promises were based on sound information. He suggested that advantage might be taken by gas undertakings to assist in pressing the Government Departments concerned. He concluded by introducing Mr. W. A. Dobson, who read a paper on the device and its functions, and Mr. D. C. E. Poole, who carried out the demonstrations.

Mr. J. H. Wilson, Chairman and Managing Director, invited questions and criticisms and paid tribute to the co-operation of the gas undertakings. The discussion included almost all who were present, and Mr. Dobson dealt with the questions, while Mr. G. L. Hughes, Chief Technical Officer of Electrolux, Ltd., replied to the various remarks raised on the subject of refrigerators. In connexion with capital expenditure, it was emphasized that the meter alone would ensure satisfactory refrigerator service in the case of the average consumer, and "Rutten" cut-off valves were only essential for the careless consumer. Those with experience of cut-off valves assured the meeting that maintenance costs were negligible.

# Physical and Chemical Reactions of Carbonization

**The following is a report of the discussion on the Paper by Mr. T. Biddulph Smith to the Manchester and District Junior Gas Association (the Paper was published in full in the "JOURNAL" of July 11).**

**The Author,** at the conclusion of his Paper, explained how the proposed form of carbonization would affect gas-works practice where the greatest possible yield of gaseous therms, at the standard quality, per ton of coal, was the first consideration. He pointed out that it was fairly well proved that at the point of maximum chemical and physical activity—that of the plastic period—there was practically no free hydrogen evolved, and that this was produced by the secondary destructive reactions during the passage of the hydrocarbon oil vapours through the pores of the coke at higher temperatures, giving a total gas having a carbon-hydrogen ratio (neglecting oxides of carbon) as low as 1.8 : 1.0. The oil vapours had then a carbon-hydrogen ratio of 9.6 to 1.0, demonstrating how much carbon had been deposited in the solid form during the secondary reactions.

The 72 lb. of available hydrogen per ton of coal was practically all in the form of hydrocarbons, and the question for the gas engineer was whether they should be destroyed to produce free hydrogen and free carbon or whether they should be recovered—as they could be recovered—and cracked by the most scientific methods now known to the world of applied science, probably using suitable catalysts.

It should be remembered that carbon itself carried by far the greatest amount of thermal energy, and this element must be maintained —as hydrocarbon—in the volatile or gaseous state to the maximum possible extent in order to obtain the largest amount of gaseous therms at a high C.V.—in other words, to retain the highest possible carbon-hydrogen ratio.

If hydrocarbon containing 72 lb. of combined hydrogen were cracked to produce ethylene, 6,544 cu. ft. of this gas would be obtained which, having a calorific value of 1,673 B.Th.U. per cu.ft., would enrich sufficient B.W.G. to produce nearly 60,000 cu.ft. of gas at 450 B.Th.U. per cu.ft. If cracked to produce methane and similarly diluted, it would produce 33,000 cu.ft. of gas of the same quality.

He did not suggest that the theoretical yield of oils would be obtained, or that, having been obtained, the oils could be cracked with such scientific precision as to produce the theoretical amount of hydrocarbon permanent gases, but he did suggest that no inefficiency in these processes could be as considerable as the present destructive dissociation process existing in natural carbonization to-day. The theoretically possible yields were so far above anything in present experience that he felt that every attempt should be made to restrict this destruction of hydrocarbons to the smallest possible extent.

**The President** (Mr. D. Benson) remarked that the Author visualized the introduction of a process which he claimed would give much better results than those achieved at present on either coke ovens or continuous vertical retorts.

Mr. **E. Harrison** (President, Coke Oven Managers' Association) remembered the experiments made when they extracted gas from the centre of the charge, and on the first analysis found the gas to add up to 102%, which they thought a wonderful result. On investigation they found that there was ethane present, which accounted for that phenomenon. Coke-oven managers and gas engineers were definitely allies and ought to pull together.

Mr. **A. Allen** (Walsall) said that while some remarkable statements had been made by the Author, he did not feel that there was any need for alarm in the Gas Industry. Mr. Smith's indictment of a wasteful method surely referred to the Coke Oven Industry, since the requirements mentioned under the heading of "The Ideal Method" had long been practised by the Gas Industry in the use of continuous vertical retorts. The results, however, fell short of what Mr. Smith would like to see. The point at issue was whether the suggested process gave the Coke Oven Industry a satisfactory metallurgical coke, and the Gas Industry ample supplies of cheap gas. The process involved new ideas, and it might not be long before they knew more about the cracking of oil than they would like to know. In referring to the economics of the process, the speaker said that what Mr. Smith put forward as the "economic aspect" meant very little indeed. Mr. Allen understood the word "economics" to mean the science and study of the general principles which governed the production and distribution of wealth, and he questioned the ability of the new process to improve the finances of either the Gas or Coke Oven Industries. Did the Gas Industry want a carbonization process that would give about 80 gallons of oil and something less than 3,000 cu.ft. of gas at a calorific value of 700/800 B.Th.U. per ton of coal, which involved further process work to produce a suitable town gas for distribution? There were many problems with a gas-making plant of that description.

Mr. **Smith** deprecated Mr. Allen's point of view. He could not reconcile the statement that "the ideal method of carbonization had long been practised by the Gas Industry" with the admission, in almost the same sentence, that the results fell short of the theoretically-possible gaseous yields. The suggested method of carbonization did not produce metallurgical coke, and therefore was of less interest to the Coke Oven Industry. Mr. Allen had asked whether the Gas Industry wanted 80 gallons of oil per ton of coke, but had apparently forgotten that oil produced so cheaply could be converted in conjunction with the coke also made, to produce a large yield of his prime requirement—gas of standard thermal value. Mr. Smith agreed with Mr. Allen that low-temperature processes were not the ideal answer to scientific carbonization. He had already pointed out the main difficulties in this direction; so far as the vertical retort was concerned, although this was a continuous process, the plastic layers were still there, and the bulk of the hydrocarbon evolved had to pass through hotter zones along the under side of them to reach the side of the retort before it could escape.

Mr. **J. A. Speers** (Preston) referred to experiments which had been made at the Fuel Research Station on the injection of oil into vertical retorts during carbonization, through tubes inserted into the centre of the retorts. It had been found that an increase occurred in the calorific value of the gas produced when the tubes were inserted, but without any oil being injected. He thought that this phenomenon could be explained by the theory Mr. Smith had propounded.

Mr. **Smith** replied that the late Dr. Sinnatt, of the Fuel Research Station, knew of his work and had been greatly interested. He did not know, however, of any independent work they had done.

Mr. **W. P. Smith** (Rochdale) said the question of heat transference through the plastic layer was one of great interest. At Bolton some 15 years ago work had been undertaken on the passage of water gas up a normal vertical retort to replace the steaming reaction. The immediate effect of this was an increased throughput of coal to approximately double the normal figure, with the same input of heat to the retort. It was apparent from the ease of rodding, together with the increased throughput, that the plastic layer had disappeared. The Author had stressed the value from the point of view of coal conservation of obtaining the maximum quantity of oils from the coal, but it was not quite clear what he proposed to do with them. It should not be forgotten that the overall thermal efficiency of the process was a matter of considerable importance. Could the Author give this figure as applied to the process he was advocating? A chart produced at the meeting showed that if the optimum quantity of oils from one ton of coal could be subjected to a controlled cracking process to give ethylene as the finished gas, and if the gas so produced were diluted with blue water gas, then 59,000 cu.ft. of 450 B.Th.U. final gas would be obtained. From a rough calculation it would appear that 14¼ cwt. of coke would be required to make the necessary water gas and, if this were so, some coke would have to be supplied from external sources. Thus, the figures given did not represent the possible gas yield per ton of coal. The use of coke on the domestic fire interested the speaker, but the only comparison given was between cokes made in the new and the normal methods from Durham coal. Could the Author give any information as to how the coke compared with that from the average Yorkshire coal? On the question of the reduction of the calorific value of the low-grade gas by blue water gas, he felt that the cost of blue water gas was rather high, and might interfere with the economics of the process.

The **Author** was interested to hear about the water gas experiment, and suggested the gas could not eliminate plasticity, this being fundamentally impossible, but could probably, both by dilution and increasing the velocity of the total gas passing through the retort, protect the hydrocarbon from excessive decomposition. He thought that a comparison of combustibility of cokes produced from Durham coal using one process and from Yorkshire coal using another process would be of little value. He did, however, put forward the tests of cokes from normal carbonization and from the new process, using Durham coal in each case. These tests were carried out in the standard radiation grate fitted with moving pyrometers covering the whole radiation field. With regard to thermal efficiency, this depended upon the efficiency with which the oils could be recovered and cracked. If they were hydrogenated and brought up to a 3 : 1 carbon-hydrogen ratio, a much greater yield of oils would accrue, the reduction in carbon-hydrogen ratio being effected by the addition of hydrogen and not by the elimination of carbon.

Dr. **A. Hamilton** (Simon-Carves, Ltd.) remarked that the combustible properties of the coke were determined primarily by the rank of the coal from which it was made. South Yorkshire coals were generally of a much lower rank than the strongly-coking coals in Durham, and the lower the rank of coal from which the coke was formed the more its combustible properties approached that of the average coke made in a vertical retort. He had produced in coke ovens from South Yorkshire coals cokes which gave performances equal to those of the average vertical retort coke. He had recently had to study the

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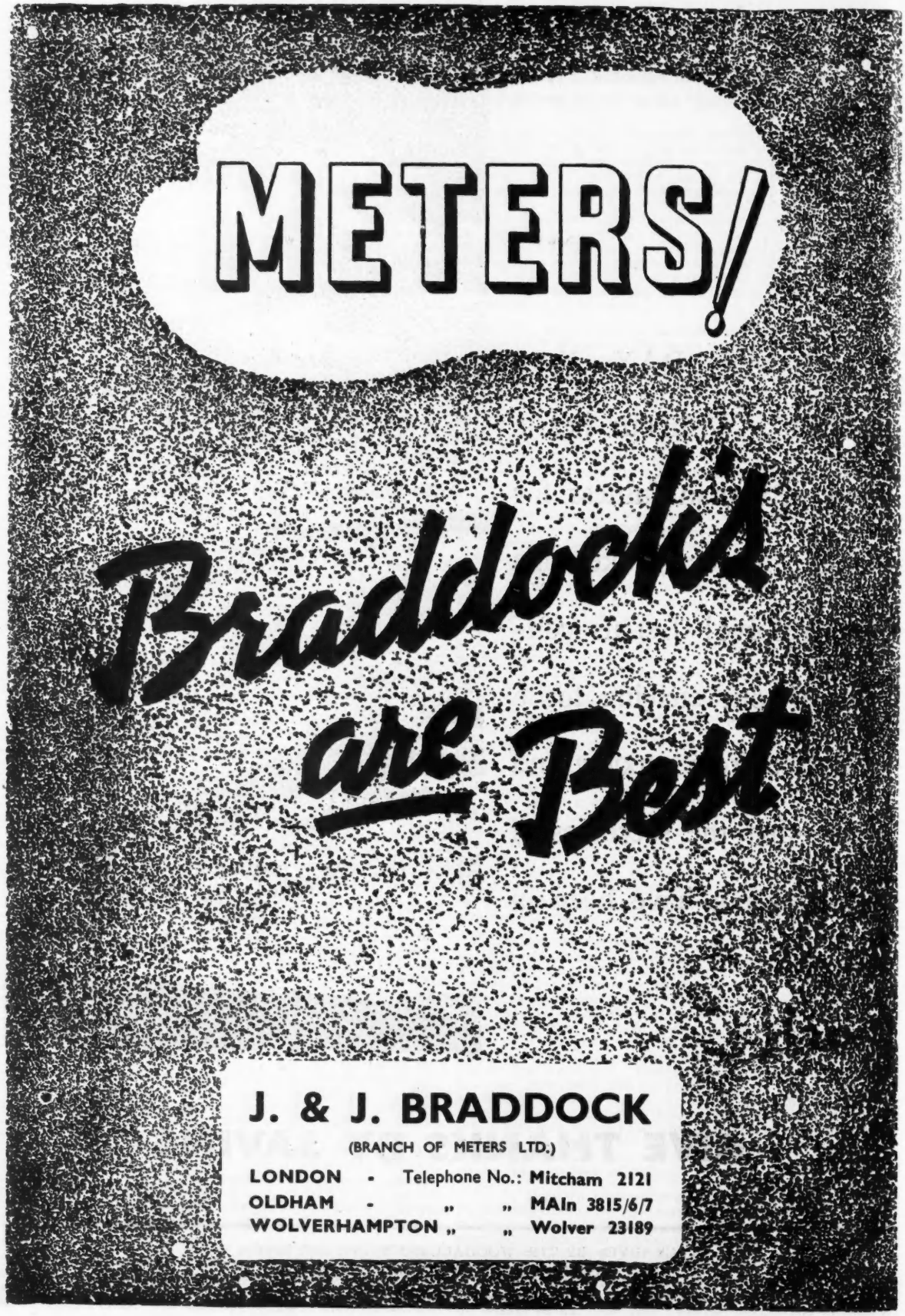
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mechanism of carbonization from a different point of view than Mr. Smith's, but there was nothing in his experience which conflicted with the evidence put forward in the Paper. The coking industry in the next 30 years would be in a difficult position because the supply of strongly-coking coals was not unlimited, and they would be continually faced with the coking of coals of a much lower rank than they had experienced in the past, and he felt that the development of the process Mr. Smith had outlined would be of considerable significance in the problem they would have to face.

Mr. **W. T. Hainsworth** (Newton-le-Willows) found the Paper of great interest, but was sure that there were not 82 gallons of oil per ton in the coal he was receiving at present. Speaking as an engineer prepared to accept a new technical view, he hoped that Mr. Smith would follow up the ideas he had expounded, the development of which was likely to be most useful at a time when plants were becoming obsolete and war-worn.

Mr. **R. S. Longhurst** (Rochdale) was worried as to how the oil was to be eventually cracked. The Author had just proposed the use of the normal water gas process, but the speaker said that this appeared no more efficient than cracking within a coke oven. In the C.W.G. process, approximately 140 gallons of oil were required to give 11,000 cu.ft. of oil gas; thus double the quantity of oil was required to give the same yield of gas as a coke oven, but the calorific value was approximately double. He would like further details of how the Author proposed to crack the oil down to ethylene or methane.

Mr. **Smith** considered that there should be no difficulty. He was no oil-cracking expert, but those who were had told him that oil-cracking had developed greatly and they could crack to what they wanted. The point to be stressed was that in both normal carbonization and the proposed process the same amount of oils was produced during plasticity, and they had a choice of allowing them to be cracked to destruction with the production of free hydrogen, or by more scientific means converting them to permanent hydrocarbon gas yielding a much higher total of gaseous therms. Carbon was the element carrying the calorific value, and must be maintained at all costs in a gaseous form. They must keep up in their finished products the carbon-hydrogen ratio as far as possible. The cracking in normal carbonization was due to the products being forced through minute passages and pores of coke material heated to from 400° to 1,000°C. and he maintained that cracking was taken to the point of destruction. In a modern cracking plant catalysts were used and considerably improved results obtained.

Mr. **H. Bromley** (Stockport) wondered how the new type of process would affect the distribution side of the Industry, as the distribution engineer was so much in the hands of the works technician. He asked whether coke made by the new process would be better or worse, from the domestic point of view, than that now produced, and would consumers still have to have specially-designed grates with greater draught. What difference would there be in the question of sulphur, which was a problem with domestic coke.

Mr. **Smith** did not see, as far as gas was concerned, that there would be any extra load on the gas distributing system when brought down to the present calorific values. The specific gravity should not be much different, and the present mains would be used in the same way. The sulphur content of the coke would not be affected, because it was ordinary coke minus the carbon deposited due to cracking of hydrocarbons.

Dr. **Hamilton** said he had tested cokes from all types of coal and from all methods of manufacture—coke ovens, vertical retorts, and horizontal retorts—all over the country, and these included the special coke which Mr. Smith had made. From these tests, carried out under rigorously-controlled conditions, he could say without qualification that this coke burnt much better than most on the market to-day. He thought that the C.A.B. was not a satisfactory one which the scientific mind could accept. The method employed constant heat input of 124 watts for five minutes on a given volume of coke prepared under carefully-controlled conditions. Obviously that input would completely ignite a particularly reactive coke and set it away very violently. The same heat input would just set another coke away and no more, while a third coke would not be ignited by this amount of heat. In such conditions the C.A.B. test could not be truly comparative. Another point was the question of constant volume employed in the test. As they would know, the crucible was filled to a certain level and the excess scraped off, but no test employing constant volume instead of constant weight could be strictly comparative. He had found that by squeezing a little more coke into the C.A.B. test a different value could be obtained. The only true method of comparing the combustibilities of coke was the fire test itself, and if this was carried out under rigorously controlled scientific conditions the performance of the various classes of coke could be brought strictly into line and, what was more, correlated with other properties, such as volatile content, density, and water content.

Mr. **L. G. Townsend** (Liverpool) questioned the statement made in the Paper that experienced operators advocated the filling of the retort as full as possible. In his opinion this was true of horizontals, but certainly did not apply to intermittent verticals. As for "cracking," this was not only desirable, but a certain amount was necessary. The Author admitted that the continuous vertical retort was the most akin to the process under discussion, and yet this type of retort gave the lowest hydrocarbon enrichment value for the gas produced of any retort. When they had obtained large amounts of paraffins, however, they had to consider whether that was what they really required. It would preclude the direct production of benzole and toluole because only paraffins would be present in the products. The crux of the whole matter was whether they should be primarily a chemical industry or a fuel industry. If the coal were to be processed for the production of chemical intermediates, then they were no longer, as they were at present, primarily a fuel industry. He could not agree that the Gas Industry was an inefficient one. Admittedly some of its products were in the form of "free carbon," but if this were to be utilized as a fuel it would not necessarily be a loss.

Mr. **Smith** remarked that he entered the Gas Industry with the belief that the gas engineer wanted as much gas as possible of a standard quality per ton of coal. He heard of large sums of money being spent on synthesizing methane to produce a greater quantity of standard gas of 450–500 B.Th.U. The last speaker, however, gave him to understand that it did not matter in what way they produced their gas so long as it was fuel. If high calorific value gaseous fuel was their aim, the present process was the only one likely to be of use to them. If, however, they were content to have carbon as coke, no process other than the one in use was of interest. So far as the indictment against the scientific world (not merely the Gas Industry) was concerned, if they would consider the matter they would find that there was a lot of truth in it. As could be seen from old pictures, 100 years ago coal was carbonized in a clay pipe and produced gas. That was still being done to-day: they had a differently-shaped retort, a better medium, and did the work more efficiently; nevertheless they were still following the practice of a century ago. They did not consider what reactions occurred in the retort. This was the most important factor, as he had tried to demonstrate, and there was a large field for research in this direction.

Mr. **A. Ormrod** (Liverpool) could not but feel that the "terrible indictment against the scientific world of to-day" was an overstatement based on scanty evidence, and to some extent that tendency was revealed in the technical aspects of the Paper. To take one example—"The graph, fig. 7, showing the rising temperature of gases leaving the chamber during carbonization plainly demonstrates this gradual but consistent increase in loss of heat." The graph in fact demonstrated no more than the rising temperature of gases leaving the chamber. It was known that the evolution of gas decreased as the end of the carbonizing period approached, and the specific heat of the "end gases" would have to be very much higher than the rich early gas if the Author's conclusion was sound, and Mr. Ormrod asked whether this was the case. Probably the principal aims of the Gas Industry were to produce a cheap gaseous therm and as reactive a solid smokeless fuel as possible, while the coke oven industry was largely concerned with the production of metallurgical coke. If there was any value in Mr. Smith's process, surely it must be as an addition to those two industries and in no sense as a replacement of them, since it could not claim to meet the needs of either. He would have welcomed much more experimental evidence (on a small scale) to support Mr. Smith's contentions, and meanwhile looked forward to the publication of results from the experimental large-scale plant to be laid down in the near future.

Mr. **Smith**, replying, could find no reason for minimizing the seriousness of the waste of hydrocarbons, and maintained that, however unpleasant, the position should be faced. The point at issue was which had the greater value: 69.2 gallons (692 lb.) of hydrocarbon oil or, when this was completely destroyed, 12,890 cu.ft. of hydrogen and 620 lb. of unreactive carbon? The main problem in the development of many of the great new chemical industries, for example hydrogenation and plastics, was the restricted supply or reasonably cheap hydrocarbons, preferably of the unsaturated type, since reaction with these was easier. The Gas Industry required the maximum yield of gaseous therms at the standard thermal value, which could not be obtained if they continued to destroy the oils. The solid smokeless fuel market was retarded in its development only because most fuels were not sufficiently reactive due to the "plating" of this deposited carbon on the otherwise very reactive primary coke. Mr. Ormrod raised the question of the gradual but consistent loss of heat passing away from the gases, but the speaker would ask Mr. Ormrod to offer any sound alternative theory as to why carbonization became progressively slower as the dimensions of the retort were increased, although the wall temperatures were maintained. If by his statement, "it is known that the evolution of gas decreases as the end of the carbonization period approaches," Mr. Ormrod suggested that there was a gradual reduction from start to finish, he was in the wrong. Much work had been done in that direction, and he should refer to graph (4) of Dr. King's paper before the Institute of Fuel, "The Gray-King Assay as a Means of Control in Gas Manufacture," or to the work in horizontal chambers of W. T. Brown, U.S.A. From these it would be seen, after the first rush of gas due to the high wall surface temperature was over and normal carbonization attained, that the yield of gas fell only slightly during the first half of the carbonization period, and then increased at the same rate until a maximum was reached, after which it tailed off rapidly.

As to the value of the suggested process, Mr. Smith put forward as the two objects:

1. To produce a more reactive coke by preventing its being "plated" with poorly reactive deposition carbon; and—

2. To prevent the destruction of valuable hydrocarbon oils, which, if preserved, could be applied to the production of petrol by hydrogenation, chemicals by synthesis, or a much greater yield of standard quality gaseous therms by efficient cracking.

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Metallurgical coke was not produced and, the suggested process, being diametrically opposite in its functions to coke oven practice, it could have little interest to producers of that material.

Mr. **H. H. Thomas** (Liverpool) said he would be interested to hear Mr. Smith explain this mechanism of carbonization as applied to the horizontal retort; if the plastic layer was completely impervious to the passage of gas, then it seemed that the gases evolved at the inner surface of plasticity would pass along the length of the decreasing core of uncarbonized coal, and this was a little difficult to imagine. The question which had arisen as to the combustibility of the coke could be determined by quoting the C.A.B. What was the V.M. content, what was the C.A.B. of the coke resulting from the process, and what were the conditions of carbonization—maximum temperature, time of carbonization, and coal weight per cu.ft. retort or oven volume? These were the factors which determined the coke combustibility apart from the rank of the original coal. Whether the relatively low combustibility of high-temperature coke was due to the subjection to high temperature or resulted entirely from the deposition of carbon in accordance with Mr. Smith's theory was a debatable point; it could be stated, however, that the combustibility of a low volatile reactive coke was reduced by heating for a relatively short period to a temperature above that at which it was prepared. On Dr. Hamilton's point concerning the unreliability of the C.A.B. test, he stated that this view was not shared by many authorities upon the subject, and the speaker had certainly found, in collaboration with others, that it was a useful indication of performance in the open fire. In that test the ignition was effected by the application of 160 watts to a predefined condition of ignition and not during a specified time. If the test was made in that way there was a marked difference between a reactive and an unreactive coke.

Mr. **Smith,** replying, did not see why Mr. Thomas had difficulty in visualizing the small amounts of "inner passage" gases evolved up to 350°C. passing along the length of the core of uncarbonized coal. If Mr. Thomas was thinking of possible resistance he would mention a series of experiments which the speaker had reported to the Cleveland Institution of Engineers in 1925 in regard to the relative resistance of coke and coal to gas passage. The coal contained 80% of material below ¼ in. and the following results were obtained:

| Sample. | Area of cross section sq.in. | Pressure difference. w.g. | Length of sample. | Time taken. hours. | Volume of gas passed. cu.ft. | Volume per sq.in. per hour in cu.ft. |
|---|---|---|---|---|---|---|
| Coke ... | 2.625 | 3 in. | 3 in. | 3 | 0.90 | 0.11 |
| ,, ... | 1.50 | 3 ,, | 3 ,, | 3 | 0.54 | 0.12 |
| ,, ... | 1.50 | 3 ,, | 3 ,, | 4 | 0.66 | 0.11 |
| Coal ... | 1.00 | 3 ,, | 7 ft. | 4 | 6.80 | 1.70 |
| ,, ... | 1.00 | 3 ,, | 7 ,, | 4 | 6.20 | 1.55 |
| ,, ... | 1.00 | 3 ,, | 7 ,, | 4 | 6.85 | 1.71 |

Coal as used in horizontal retorts was not so fine as in the case cited, so that resistance to gas passage would be proportionately less. Mr. Thomas would admit that if those gases would not pass along the core they must first pass through the plastic layer, which Foxwell's work had shown to be practically impossible, and then through coke offering the resistance given.

So far as the C.A.B. test was concerned, Mr. Smith agreed with Dr. Hamilton that no one having access to the most modern grate test with mechanically-operated pyrometers covering the whole field of radiation would seriously return to that test which, at the time it was devised, was the best comparative method known. For the benefit of those who believed in the C.A.B. test the figures were as follows from the same Durham coal having the same analysis and carbonized at the same temperature:

| | C.A.B. |
|---|---|
| Normal coke .. .. .. .. | 0.064 (6 minutes). |
| Coke produced by the new process .. | 0.045 (5 minutes). |

Mr. **F. Cartledge** (Oldham) proposed and Mr. **A. Ormrod** (Liverpool) seconded a vote of thanks to the Author, and Mr. **Smith** responded.

## The Stoker's Manual

The Fuel Efficiency Committee of the Ministry of Fuel and Power has prepared a booklet for the stoker, giving him both practical details of the best way of doing his job, and explanations as to why the job should be done in a certain way. Copies can be obtained from H.M. Stationery Office, price 6d., or from any bookseller.

A great deal of fuel can be saved or wasted according to the design and selection of plant, but the man who lives on the job, the man who actually handles the coal, is the stoker. The stoker may be responsible for expending more of a firm's money (in the form of fuel) than anyone else outside the cashier's office. It is thus of great importance that every possible opportunity should be given to the stoker to improve his knowledge.

The Manual consists of five parts. The first deals with the operation of shell boilers. Part 2 is a handy summary of Part 1 in the form of an *aide-mémoire*. Part 3 is concerned with sectional central heating boilers, the operation of which involves a special technique. Methods of operation and of overhaul, the special features of day and night working, together with drawings of good sets of tools, are included. Part 4 is a summary of Part 3. In Part 5 there are explanations of what happens in combustion under various conditions, some account of what coal is, and of the differences between different types of coal, of excess air and its effects, and of draught.

## Shrewsbury's Post-War Kitchen

To cater for the public interest in modern kitchen development, the Shrewsbury Gas Light Company has erected in its showroom a model kitchen, fabricated from the best material available, and fitted with various gas-using appliances. It is not claimed that this is an ideal kitchen, but is constructed to demonstrate some of the more modern ideas and possibilities for post-war kitchens. The apparatus includes a gas cooker with elevated oven and hotplate at the side, domestic coke

boiler for winter use, working in conjunction with gas-heated circulator for summer use, gas-heated clothes-drying cupboard, gas-heated washing machine, hand operated, and built-in refrigerator. The equipment includes a sink with two enamelled iron draining trays and cupboards with sliding doors, for food and utensils. There is also on view an electrically driven, gas-heated washing machine of the latest design.

A competition is being run in connexion with the exhibition inviting comments and suggestions with regard to the arrangements and details of the kitchen.

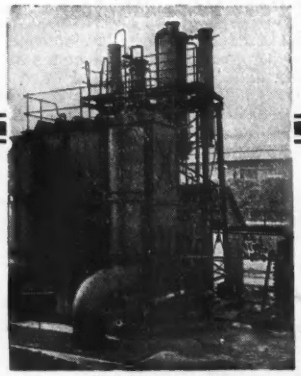
## Home-Making Course at Leeds

A room in the Market Hall headquarters of the Leeds Gas Department has been converted into a kitchen for use in a Home-Making Course for members of the W.A.A.F. and also instructors in the A.T.S. The scheme is run under the aegis of the Regional Committee for Adult Education in H.M. Forces in connexion with Educational Vocational Training. Twelve girls attend each week, and it is anticipated the course will run for 12 months at least.

In addition to cookery, instruction is given in the use of a gas cooker, how to spend points, clothing coupons, and furniture units to the best advantage, and a visit is arranged to a large store to see clothing and furniture. Great enthusiasm and appreciation have been evident in all the lectures and demonstrations, and the girls show healthy rivalry in turning out the best results when they do their practical work.

**The New Depot** of Cox & Danks, Ltd., at Wadsley Bridge, Sheffield, is now completed, and is open to accept iron and steel scrap, and to supply plant, machinery, and steel sections. The telephone number is Sheffield 44291.

**The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.**



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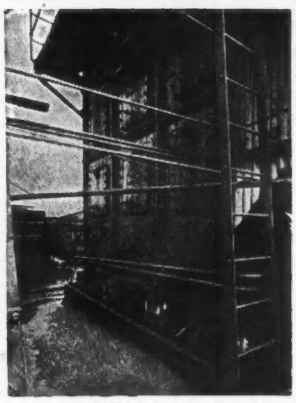

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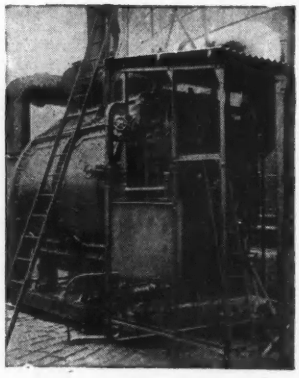

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# Products Prices—Stocks and Shares

## The London Market Aug. 6.

The prices of Coal Tar Products are unchanged.

As from March 5, by the Coal Tar Products Prices Order, 1945 (S. R. & O. 1945, No. 229), the maximum price of Pitch for briquetting has been increased to 60s. per ton f.o.r. supplying works, and the prices for Road Tar, as fixed by the Coal Tar Products Prices Order, 1943, S. R. & O. No. 1528, have been increased by one half-penny per gallon. There is also an increase of 5s. per ton in the price of standard Creosote/Pitch Mixture.

The only change to report in connexion with the prices of Coal Tar Products is the coming into effect on June 11 of a new Government Order increasing the prices of Coal Tar Spirits. This Order is entitled the Control of Benzole and Coal Spirit Order, 1945 (S. R. & O. 1945, No. 681).

Control of Toluene (No. 4) Order, 1944 (S. R. & O. 1944, No. 170), contains an amendment of the Control of Toluene (No. 3) Order, 1943.

Coal Tar Products Prices (No. 2) Order, 1944 (S. R. & O., 1944, No. 1051), allows increases in the maximum prices for all forms of Naphthalene.

## The Provinces Aug. 6.

The average prices of gas-works products during the week were : Pitch and Crude Tar,* Toluole, naked, North, 90's. 2s. 4d. to 2s. 6¾d., pure, 3s. 2¼d. (now controlled by S. R. & O. 1945, No. 681), operative from June 11, 1945. Benzole and Coal Spirit, also Coal Tar Naphtha and Xylole, are now controlled by the Control of Benzole and Coal Spirit Order, 1945, dated June 1, 1945, S. R. & O. 1945, No. 681, operative from June 11, 1945. Carbolic acid, 60's, anthracene, creosote oil (hydrogenation), coal tar oils (timber preservation, &c.), and strained anthracene oil controlled by the Coal Tar Products Prices Order, 1943, dated Oct. 20, 1943 (S. R. & O. 1943, No. 1528), operative from Nov. 15, 1943. Naphthalene now controlled under S. R. & O. 1944, No. 1051, operative from Sept. 22, 1944.

Attention is called to Coal Tar Products Prices Order, 1945 (S. R. & O. 1945, No. 229), referred to on p. 305, "JOURNAL" of March 7.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

## Scotland Aug. 4.

Market continues rather quiet. Refined tar*: Yield to Distillers is 5d. per gallon *ex* Works, naked. Creosote oil: Timber preserving quality,* 5¼d. to 6¼d.; hydrogenation oil,* 5⅞d.; low gravity or virgin oil,† 7¼d. to 7½d.; benzole absorbing oil,* 6½d. to 8d. per gallon. Refined cresylic acid* is 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha†: 7d. to 8d. per gallon. Solvent naphtha*: Basic prices delivered in bulk, 90/160 grade, 2s. 10d., and 90/190 Heavy naphtha, Unrectified, 2s. 0¼d.; Rectified, 2s. 4d. per gallon. Pyridine†: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

* Price controlled. † Uncontrolled.

Until the new Government's programme is available it would be premature to forecast the trend of gas stock prices, but the list below shows the extent of the depreciations in value up to Thursday last. It will be seen that Imperial Continental tops the list with a fall of 16½ points, and Gas Light units are not far behind, closing 2s. 6d. lower at the *ex div.* price of 20s. 9d. Tottenham, Wandsworth, and Watford ordinaries were all about 9 points down.

**OFFICIAL LIST**

| | | |
|---|---|---|
| Bombay ... ... ... ... | 42/—43/- | —1/- |
| British Ord. ... ... ... | 130—135 | —2 |
| Cardiff Ord. ... ... ... | 125—130 | +1 |
| Commercial Ord. ... ... | 59—64 | —3 |
| Croydon max. div. ... ... | 105—110 | —1 |
| Gas Light Units (*x.d.*) ... | 20/6—21/6 | July 30 |
| Ditto 3½ p.c. max. (*x.d.*) ... | 76—81 | " |
| Ditto 4 p.c. Pref. (*x.d.*) ... | 101—104 | " |
| Imperial Continental ... | 100—110 | —16½ |
| Ditto 3½ p.c. Deb. (*x.d.*) ... | 97—100 | July 30 |
| Liverpool Ord.... ... ... | 125—130 | —3 |
| Montevideo Ord. ... ... ... | 98—103 | —2 |
| Plymouth and Stonehouse Ord. ... | 110—115 | —3 |
| Portsmouth Cons. ... ... ... | 155—160 | —2 |
| Primitiva Holdings ... ... | 11/—12/- | —/6d. |
| South Metropolitan Ord. ... ... | 85—90 | —2 |
| Ditto 6 p.c. Pref. ... ... | 127—132 | —1 |
| South Suburban Ord. (*x.d.*)... ... | 113—118 | July 30 |
| Ditto 5 p.c. Pref. (*x.d.*) ... ... | 111—116 | " |
| Ditto 4 p.c. Pref. (*x.d.*) ... ... | 99—104 | " |
| Ditto 3½ p.c. Red. Pref. (*x.d.*) ... | 93—98 | " |
| Southampton Ord. ... ... ... | 107—111 | —1 |
| Tottenham Ord. ... ... ... | 113—118 | —8 |
| Ditto 5 p.c. Pref. ... ... ... | 112—117 | —1 |
| Uxbridge Ord. ... ... ... | 122—127 | —3 |
| Wandsworth Cons. (*x.d.*) ... ... | 113—119 | July 30 |
| Ditto 4 p.c. Pref. (*x.d.*) ... ... | 102—105 | " |
| Watford Ord. ... ... ... ... | 113—118 | —9 |

**SUPPLEMENTARY LIST**

| | | |
|---|---|---|
| Cambridge Cons. "B" (*x.d.*) ... | 141—146 | July 30 |
| Croydon 4 p.c. Pref. ... ... ... | 98—103 | —2 |

**PROVINCIAL EXCHANGES**

| | | |
|---|---|---|
| Newcastle Units ... ... ... | 26/9—27/3 | +-/1½d. |
| Sheffield Cons. ... ... ... | 152—154 | +1 |
| Sunderland ... ... ... ... | 124—126 | +3 |


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SPENT OXIDE BOUGHT.

**BALE & CHURCH, LTD.**

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Telephone: Mansion House 1156. Telegrams: "Balefire, London."

**PATENTS**

MEWBURN, ELLIS & CO.,
CHARTERED PATENT AGENTS
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(Director, B. T. King, A.I.M.E., Patent Agent)

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**EDUCATIONAL**

**AUTHORITATIVE CORRESPONDENCE TRAINING**

*T.I.G.B. Students have gained 29 FIRST PLACES and Hundreds of Passes in the Examinations for A.M.Inst.C.E., A.M.I.Gas E., A.M.I.Chem.E., A.M.I.Mech.E., A.M.I.E.E., C. & G., etc.*

**Qualify Now by Home-Study with the T.I.G.B.**

The Department of Fuel Technology covers **Gas Supply, Gas Engineering, Gas Power, Engineering,** and the **Certificates of The Institution of Gas Engineers.**

Write to-day for "Engineer's Guide to Success"—FREE—containing the world's widest choice of engineering courses—over 200—and which alone gives the Regulations as to admission to various examinations such as A.M.I.Gas E., A.M.Inst.C.E., A.M.I.Mech.E., A.M.I.Chem.E., C. & G., &c. The **T.I.G.B.** guarantees training until successful.

**THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN**

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**PLANT &c.**

**FIRTH BLAKELEY, SONS & CO., LTD.** Vulcan Ironworks, Church Fenton, Yorks.

**MANUFACTURERS of Gas-holders, Tanks, Condensers, Purifiers, Scrubbers, Washers, and every description of Gas Plant.**

**Sole Makers of the "P.M" semi-water Gas Plant.**

*Telegrams:* "Blakeleys, Church Fenton."
*Telephone:* Barkston Ash 234 and 235 (Private Branch Exchange). Code: "Bentleys."

**ROBERT DEMPSTER & SONS, LTD., ELLAND, Builders of CARBONIZING PLANTS, both Horizontal and Vertical. Manufacturers of CONDENSERS, PURIFIERS, GAS-HOLDERS, &c., also every description of COAL and COKE HANDLING PLANT.** *Telegrams:* "Dempster, Elland." *Telephone:* Elland 2241, 2242 and 2243.

*THE "FLUXITE QUINS" AT WORK*

*"We shan't need that FLUXITE to-day,*
*We've certainly come the wrong way.*
*This can't be the right house.*
*It says here the 'White House'—*
*"I thought it said LIGHTHOUSE!" bawled EH.*

**For all SOLDERING work—you need FLUXITE—the paste flux—with which even dirty metals are soldered and "tinned." It does not "poison" the solder nor corrode the metal—and can be used with safety even on sensitive apparatus.**

**With Fluxite, joints can be "wiped" successfully that are *impossible by any other method.***

**FLUXITE has been used for over 30 years in Government Works and by the leading Engineers and Manufacturers. OF ALL IRONMONGERS — in tins — 8d., 1s. 4d., and 2s. 6d. Ask to see the FLUXITE POCKET BLOW LAMP, price 2s. 6d.**

The FLUXITE GUN puts FLUXITE where you want it by a simple pressure.

Price 1s. 6d. or filled 2s. 6d.

ALL MECHANICS *WILL* HAVE

**FLUXITE**

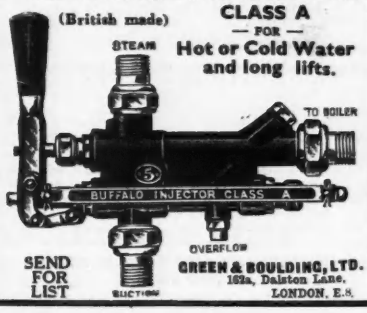
**IT SIMPLIFIES *ALL* SOLDERING**

*Write for Leaflets on CASE HARDENING STEEL and TEMPERING TOOLS with FLUXITE also on "WIPED JOINTS." Price 1d. each.*

**Fluxite Ltd. (Dept. G.J.), Bermondsey Street, S.E.1**

**BUFFALO INJECTOR**

(British made) CLASS A — FOR — Hot or Cold Water and long lifts.




SEND FOR LIST

GREEN & BOULDING, LTD. 162a, Dalston Lane, LONDON, E.8.

## APPOINTMENTS VACANT

*None of the situations advertised in these columns relates to a man between the ages of 18 and 50 inclusive or a woman between the ages of 18 and 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.*

**URGENTLY REQUIRED. — ENGINEERING** DRAUGHTSMEN, mechanical and structural. FITTERS, PLATERS, PLATERS' HELPERS, and STEELWORK ERECTORS. Apply to Messrs. W. J. Jenkins & Co., Ltd., Beehive Works, Retford, Notts.

### SIDMOUTH URBAN DISTRICT COUNCIL

(GAS DEPARTMENT)

**WORKS FITTER required for Gas-works.** Good mechanic used to maintenance and repairs of machinery and plant. Present wages £4 11s. 7d. per week, including War Bonus.

Particulars can be obtained from the Gas Engineer and Manager, Gas-Works, Alexandria Road, Sidmouth.

Council Offices, Sidmouth. R. PICKARD, Clerk of the Council.

August 1, 1945.

### PORTSMOUTH AND GOSPORT GAS COMPANY

GENERAL MANAGER

**THE Directors of the Portsmouth and Gosport** Gas Company invite applications for the position of GENERAL MANAGER (vacant through the death of Mr. Thomas Carmichael).

Testimonials are not required in the first instance, but applicants should state their Age, Qualifications, Experience, present position and salary expected.

Letters, marked "Private," to be sent, by September 8, 1945, to the Chairman, Portsmouth and Gosport Gas Company, Chief Offices, The Square, Portsmouth.

### COUNTY BOROUGH OF SOUTHPORT

APPOINTMENT OF GAS ENGINEER AND MANAGER

**THE Council invite applications for the appointment** of GAS ENGINEER AND MANAGER, at a commencing salary of £1,000 per annum, rising by annual increments of £50 to a maximum of £1,250 per annum, plus the appropriate cost of living bonus. In a suitable case the selected applicant may be appointed at a salary in excess of the commencing salary.

Applicants must be duly qualified Engineers, possessing technical, administrative and commercial qualifications. The person appointed must devote the whole of his time to the duties of the office.

The appointment will be determinable by either side on three months' notice, and will be subject to the provisions of the Local Government Superannuation Act, 1937. The selected candidate will be required to pass a medical examination.

Applications, stating Age, Qualifications, present appointment and duties, and full details of experience, accompanied by *copies* of not more than three recent Testimonials, must be delivered to the undersigned in a sealed envelope endorsed "Gas Engineer and Manager" not later than August 31, 1945.

Canvassing directly or indirectly will disqualify a candidate.

Town Hall, Southport. R. EDGAR PERRINS, Town Clerk.

August 8, 1945.

*(Classified Advertisements continued on p. 210)*

## APPOINTMENTS VACANT
*(continued)*

**WANTED.—WORKS CHEMIST.** Salary £300 per annum. Apply, giving full particulars, with *copies* of three Testimonials, to the Engineer and Manager, Chester United Gas Company, Gas-Works, Chester.

**TECHNICAL ASSISTANT required, having experience** in the manufacture (Verticals) and distribution of Gas. Commencing Salary £340.
Apply, stating Age, Experience, etc., to G. P. MITCHELL, Managing Director, Worcester New Gas Light Company.

**FITTINGS SUPERINTENDENT required. Small** house available at low rental.
Apply, stating Age, Qualifications and Salary required, to G. P. MITCHELL, Managing Director, Worcester New Gas Light Company.
July 25, 1945.

**WELL established firm of Tar Distillers and** Benzole Refiners require Assistant Works Manager, with full knowledge of distillation and refining of Tar and Benzole products. State in confidence, Age, Experience, Qualifications and Salary required to No. 9456, "GAS JOURNAL," 51, High Street, Esher, Surrey.

**REQUIRED.—MAINTENANCE FITTER with Gas** Works experience. Preferably with horizontal plants on small works. Single man preferred, able to drive. Apply Severn Valley Gas Corporation, The Gas-Works, Cheltenham.

### THE WATFORD AND ST. ALBANS GAS COMPANY
ASSISTANT INDUSTRIAL GAS ENGINEER

**APPLICATIONS are invited for the Position of** ASSISTANT INDUSTRIAL GAS ENGINEER at a commencing salary of £400 per annum, inclusive of war bonus.
Applicants should not be more than 35 years of age, and have a good technical knowledge and practical experience of the application of town's gas for industrial and commercial purposes.
Applications, stating Age, Qualifications and Experience together with *copies* of two recent Testimonials and position in relation to Essential Works (General Provisions) Order should reach the undersigned not later than August 25.

The Watford and St. Albans Gas Company,
Clarendon Road,
Watford.
T. C. BATTERSBY,
General Manager and Chief Engineer.

### ATHERTON URBAN DISTRICT COUNCIL
APPOINTMENT OF GAS AND WATER ENGINEER AND MANAGER

**APPLICATIONS are invited for the Position of** Gas and Water ENGINEER AND MANAGER, at a commencing salary of £525 per annum, plus war bonus (at present £59 16s.).
Candidates must be Corporate Members of The Institution of Gas Engineers, and must have had practical experience in the control of Gas and Water Undertakings. Experience in the working of a Benzole Recovery Plant will be an advantage.
The appointment, which will be subject to the provisions of the Local Government Superannuation Act, 1937, and the passing of a medical examination, will be determinable by three months' notice on either side. The successful candidate will be required to reside within the Urban District.
Applications, stating Age, Qualifications and Experience and information as to position under the National Service Acts and the Registration of Employments Order, accompanied by *copies* of three recent Testimonials and endorsed "Gas and Water Engineer," must reach the undersigned not later than August 15, 1945.
Canvassing either directly or indirectly will be a disqualification, and candidates must disclose whether they are related to any member or senior officer of the Council.

Town Hall,
Atherton,
Manchester.
July 30, 1945.
W. BALSON,
Clerk of the Council.

### BRIXHAM GAS AND ELECTRICITY COMPANY

**APPLICATIONS are invited for the Position of** GAS-WORKS SUPERINTENDENT. Applicants should possess a sound mechanical training and the ability to carry out routine chemical and physical testing. Experience with Woodall Duckham Vertical Retorts, Carburetted Water Gas and Activated Carbon Benzole Recovery Plants an advantage.
Possession of The Institution of Gas Engineers' Higher Grade Gas Engineering (Manufacture) Certificates preferable, but not essential.
Salary £300 per annum, plus war bonus, plus gas, electricity, and coke at half price.
Applications, giving details of Age, Training, and Experience, and stating position under the Essential Work Order, together with *copies* of two recent Testimonials, to be sent to the Engineer and General Manager, Brixham Gas and Electricity Company, Brixham, Devon.

### WELLS GAS LIGHT COMPANY

**APPLICATIONS are invited for Position of Assis-** tant Engineer and Manager to the above Company, at a Salary of £300 per annum with House, Gas, and Coal free.
Candidates must be qualified Gas Engineers, and have a thorough knowledge and experience of control and maintenance of Gas-Works Plant, and also capable of drawing up specifications and preparing Plans for extensions or alterations; experience in distribution will be considered an advantage.
Applications, stating Age, Experience and Qualifications, together with *copies* of three recent testimonials, must reach the undersigned not later than August 23, 1945.

Gas Offices,
Wells,
Somerset.
CLARENCE DUNN,
Engineer, Secretary and Manager.

### BOROUGH OF STOURBRIDGE
(GAS DEPARTMENT)
DISTRIBUTION SUPERINTENDENT

**APPLICATIONS are invited for the Position of** DISTRIBUTION SUPERINTENDENT with the above Undertaking. Applicants should possess the Higher Grade Certificate of The Institution of Gas Engineers (Gas Supply) or equivalent qualifications. The commencing salary will be dependent on the experience and qualifications of the candidate, and will be in the grade of £290 to £335, rising by annual increments of £15, plus cost of living bonus of £59 16s. A house will be provided by the Gas Department at a low rental. The appointment will be subject to the Local Government Superannuation Acts, and the successful applicant will be required to pass a medical examination. Applications, stating Age, Experience, and Qualifications, together with position in relation to the Essential Works Order, should be sent to the Town Clerk, Council House, Stourbridge, so as to be received before August 20, 1945, together with *copies* of three testimonials.

Gas-Works,
Stourbridge.
July 30, 1945.
S. J. D. WILLIAMS,
Engineer and Manager.

### BOROUGH OF NELSON
(GAS DEPARTMENT)
DISTRIBUTION SUPERINTENDENT

**APPLICATIONS are invited for the Position of** DISTRIBUTION SUPERINTENDENT.
Candidates must have a thorough knowledge and sound practical experience of the distribution and sales of gas for both domestic and industrial purposes.
The salary will be £325 per annum plus war bonus (at present £59 16s. per annum), and will, subject to satisfactory service, be increased to £350 per annum plus war bonus at the end of the first year's service.
The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937, and the successful candidate will be required to pass a medical examination.
The appointment will be terminable by one month's notice on either side.
Applications endorsed "Distribution Superintendent," stating Age, Qualifications and Experience, and accompanied by *copies* of three recent Testimonials, must be delivered to the undersigned not later than Tuesday August 14, 1945.

Town Hall,
Nelson.
July 26, 1945.
F. W. ROBERTS,
Town Clerk.

### DISTRIBUTION ENGINEER

**APPLICATIONS are invited for the appointment** of DISTRIBUTION ENGINEER.
Applicants must be experienced in all branches of Gas Utilization and Distribution and Workshop Practice, and have a thorough knowledge of high and low pressure supply. Applicants must have sound training and experience in the planning and estimating of distributing systems.
Applicants must be qualified Distribution Engineers possessing recognized technical qualifications. Preference will be given to Applicants possessing the Institution of Gas Engineers' Higher Grade Certificate (Gas Supply) or equivalent. The successful applicant will be required to pass a medical examination and to contribute to the Superannuation Funds under the Superannuation Acts.
Salary rising to £600 per annum plus War Bonus (at present £60), with placing on the Scale according to qualifications.
Applications, accompanied by recent Testimonials, stating Age, Qualifications and Experience, should be addressed to No. 9455, "GAS JOURNAL," 51, High Street, Esher, Surrey, and received not later than Saturday, August 18, 1945.

## CONTRACTS OPEN

### MANSFIELD CORPORATION
(GAS AND WATER DEPARTMENT)

**TENDERS are invited for the following:—**
(*a*) Cast-Iron Main, approximately 2,640 yards 12 in. with flexible joints; various specials for same.
(*b*) Steel Main, approximately 2,640 yards 12 in. with welded joints. Main to be coated and wrapped; various specials for same.
(*c*) Mainlaying, the laying of the above mentioned main.
Further particulars can be obtained from the Engineer and Manager, Gas and Water Department, Lime Tree Place, Mansfield. Tenders in plain sealed envelopes, endorsed "Tender for Gas Main or Mainlaying," to be delivered to the undersigned on or before September 10, 1945.

Carr Bank, Mansfield.
July 30, 1945.
A. C. SHEPHERD,
Town Clerk.

## PLANT &c. FOR SALE & WANTED

'PHONE 98 STAINES.

**FOR SALE.—Weir Feed Pump, 8½ in. by 6 in. by** 13 in.; Spencer Hopwood Boiler, 10 ft. by 4 ft. 3 in., 90 lb.; Sectional Steel Tank, 16 ft. by 16 ft. by 4 ft.; Steel Tank, 26 ft. by 10 ft. by 8 ft.; Weir Service Pump, 7 in. by 7½ in. by 18 in.; 30 h.p. H.S. Enclosed Steam Engine; 10 h.p. Steam Turbine.
HARRY H. GARDAM & CO., LTD., STAINES.

CAST IRON PIPING FOR SALE

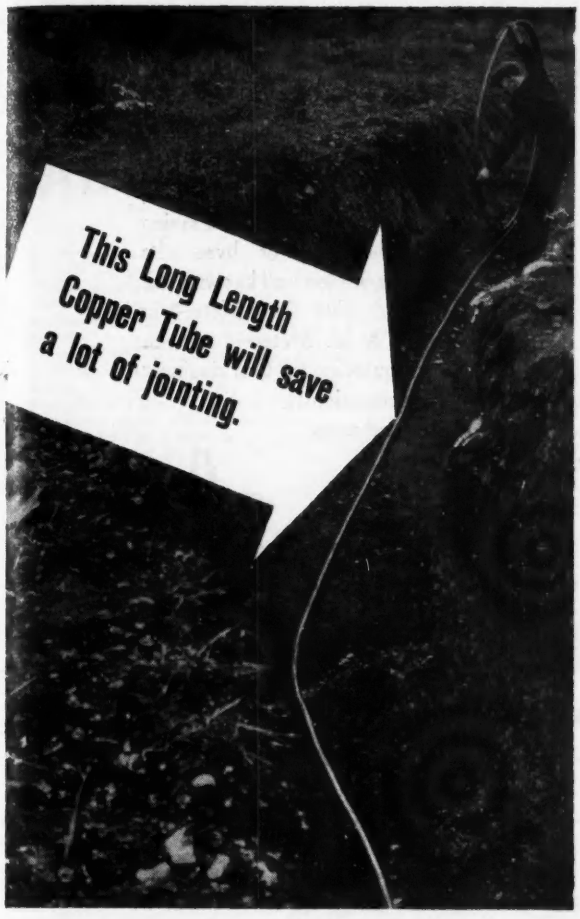
3 24 in. dia. by 8 ft. 5 in. long spigot and socket.
4 24 in. dia. by 9 ft. long flanged and socket.
1 24 in. dia. to 18 in. by 4 ft. 2½ in. flanged.
1 24 in. dia. by 5 ft. 1 in. long spigot and socket.
3 24 in. dia. flanged and spigot bends 2 ft. 10½ in. by 2 ft. 5 in.
1 24 in. ,, bend 2 ft. 10½ in. by 2 ft. 10½ in.
1 24 in. ,, ,, 3 ft. 2½ in. by 2 ft. 10 in.
1 24 in. ,, ,, 3 ft. by 3 ft. 3 in.
1 18 in. ,, ,, 1 ft. 9 in. by 1 ft. 10 in.
1 18 in. ,, ,, 2 ft. 3½ in. by 1 ft. 9 in.
3 24 in. Tees flanged one end and branch the other end socket 4 ft. 3 in. by 2 ft. 3 in.
1 24 in. dia. flanged Tee with 18 in. branch 4 ft. 6 in. by 1 ft. 9½ in.
1 24 in. dia. flanged Tee one end spigot 4 ft. 4½ in. by 2 ft. 3 in.
4 24 in. Cast Iron Valves by Bryan Donkin, Ltd.
1 24 in. Cast Iron Valve Bronze working faces 23½ in. through by Blakeborough.
1 24 in. Cast Iron Valve 11½ in. through by Blakeborough.
4 18 in. Cast Iron Valves by Bryan Donkin, Ltd.

NELSONS SILK, LTD., Caton Road, Lancaster.

## REPAIR WORK

**CLOCKWORK Controllers for Public Lighting** Control and Time Switches, Clocks and all type of instruments and appliances operated by Clockwork Repaired, Overhauled and Guaranteed. Inquiries welcomed. J. W. & R. E. Hughes (Clockwork Engineers), 58, Victoria Street, London, S.W. 1. ('Phone Victoria 0134.)

STANTON
Spun Iron
PIPES




Installation costs of Gas supply services will be much reduced by the use of "KUTERLON" Long Length Copper Tube which is now supplied in coil form in lengths up to 60 ft. Annealing or the use of mechanical bending appliances are not necessary. Bending can be done by hand, and the tube can be laid easily in trenches and run round obstructions such as rock or tree trunks. "KUTERLON" will be available for post-war reconstruction, but meantime is supplied to current licensing regulations. Full information will be supplied on request.

**IMPERIAL CHEMICAL INDUSTRIES LIMITED**
LONDON, S.W.1

M.28

# HUMIDINE
## NON-SETTING PAINT

**Used by the leading Gas Companies for the protection of the lower plates and cuppings of gas-holders. The most efficient anti-corrosion paint in existence**

**HUMIDINE NEVER DRIES, NEVER CRACKS AND IS ABSOLUTELY IMPERVIOUS TO WATER**

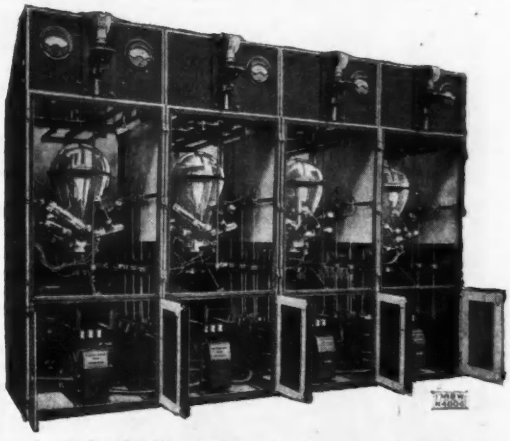
## OXY-GRAFITE PAINT

**For the Protection against the corrosive effects of acid and alkaline fumes on all iron and steel-work of gasworks, Aspinalls Oxy-Grafite Paint is unsurpassable**

*Full particulars and prices on request from the sole proprietors*

**ASPINALLS (PAINTS) LIMITED**
CARLETON — SKIPTON — YORKS

# Mercury-Arc Rectifiers
*for Gas Works*
*Electrical power supply*

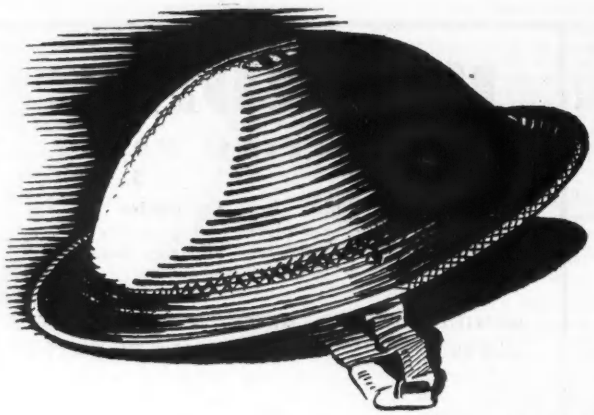


*four-bulb Electric-Construction Mercury-Arc Rectifier*

*Input: 400 volts, three-phase 50 periods*
*Output: 220 volts, 1200 amperes*

*The equipment is arranged for six-phase rectification, with four bulbs running in parallel*

The **ELECTRIC CONSTRUCTION Co.** Ltd.
WOLVERHAMPTON



# PROTECTION..

THE STEEL HELMET—more familiarly known as the "Tin Hat"—has, since its inception, been the means of saving hundreds and thousands of lives. Its protective qualities are too well known to be enlarged upon. The Gas Meter—in particular the A. & M. Meter—has been the means of safeguarding the Gas Engineer from many complaints about gas consumption which otherwise would have descended upon his unprotected head.

your *protection* is the

## "A&M" METER

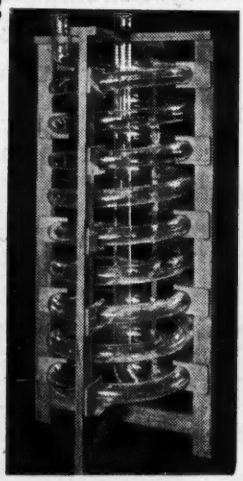
ALDER & MACKAY LTD., NEW GRANGE WORKS, EDINBURGH, 11.

## PUMP THROUGH GLASS!

*It's cleaner! safer!*

The transparency of PYREX Brand Glass Pipe Lines is a valuable aid to quality maintenance, and permits the visual inspection of flow, colour and quality of the liquids carried, and the detection of lime scale, sediment and crystallization.

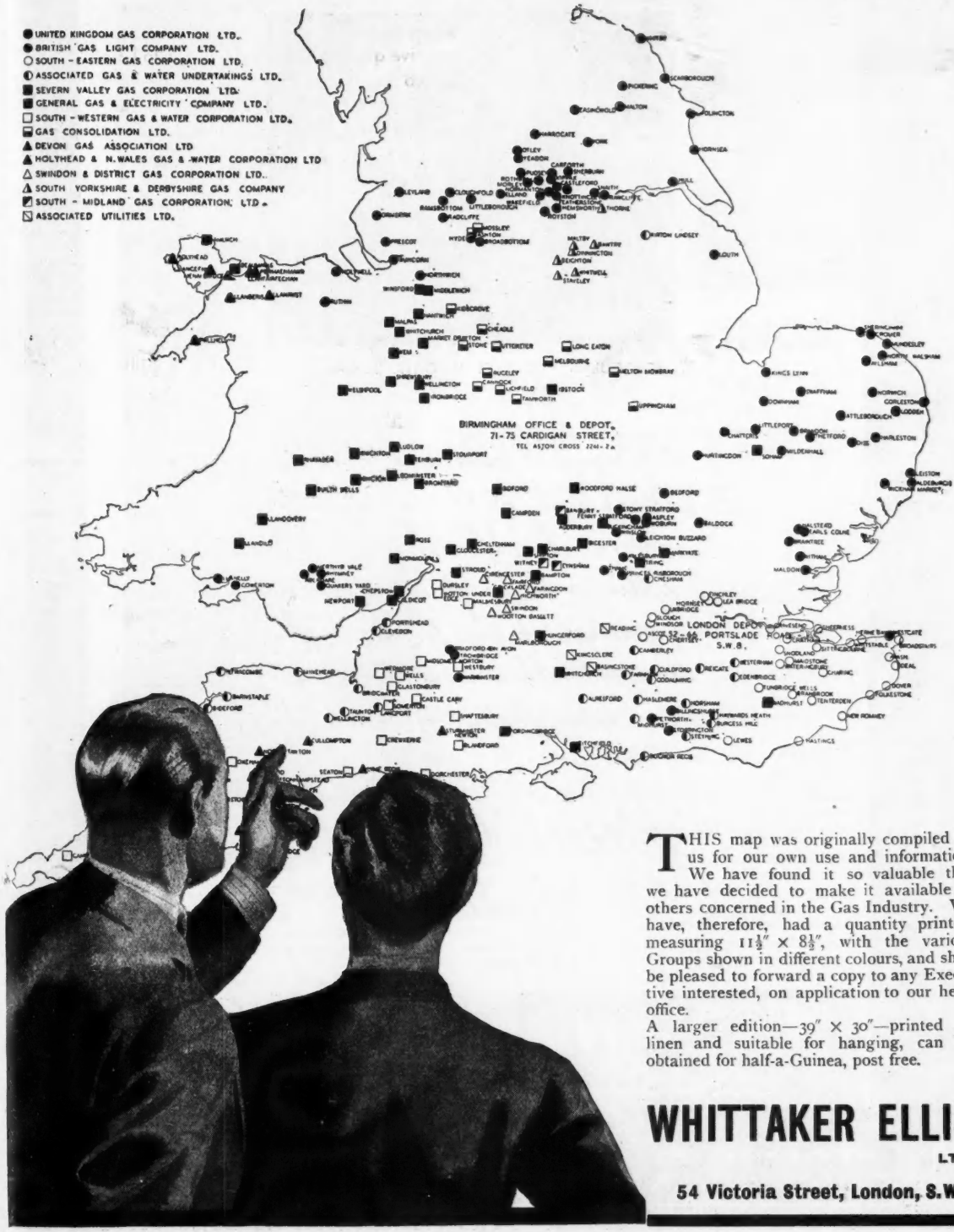
PYREX Brand Glass Pipe Lines will operate at pressures up to 50 lbs. per square inch, and possess mechanical strength ample for most chemical and manufacturing processes. Can be flushed through with steam, hot water, hot alkali detergent or hot mild acid solutions.



**PYREX** BRAND REG. TRADE MARK **GLASS PIPE LINES**

Made by
JAMES A. JOBLING & CO., LTD
SUNDERLAND

# *The Associated Groups of the*
# GAS INDUSTRY OF ENGLAND & WALES

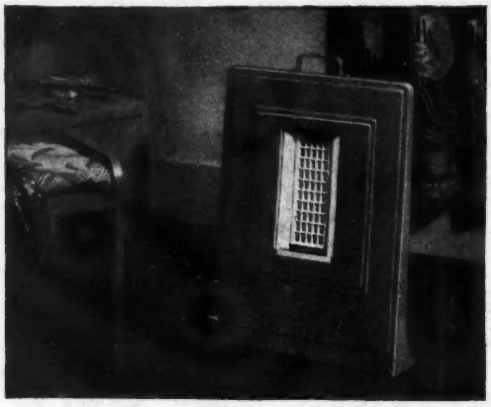

UNITED KINGDOM GAS CORPORATION LTD.
BRITISH GAS LIGHT COMPANY LTD.
SOUTH-EASTERN GAS CORPORATION LTD.
ASSOCIATED GAS & WATER UNDERTAKINGS LTD.
SEVERN VALLEY GAS CORPORATION LTD.
GENERAL GAS & ELECTRICITY COMPANY LTD.
SOUTH-WESTERN GAS & WATER CORPORATION LTD.
GAS CONSOLIDATION LTD.
DEVON GAS ASSOCIATION LTD.
HOLYHEAD & N. WALES GAS & WATER CORPORATION LTD
SWINDON & DISTRICT GAS CORPORATION LTD.
SOUTH YORKSHIRE & DERBYSHIRE GAS COMPANY
SOUTH-MIDLAND GAS CORPORATION, LTD.
ASSOCIATED UTILITIES LTD.
BIRMINGHAM OFFICE & DEPOT,
71-75 CARDIGAN STREET,
LONDON DEPOT
PORTSLADE ROAD,
S.W.8.

THIS map was originally compiled by us for our own use and information. We have found it so valuable that we have decided to make it available to others concerned in the Gas Industry. We have, therefore, had a quantity printed, measuring 11½" × 8½", with the various Groups shown in different colours, and shall be pleased to forward a copy to any Executive interested, on application to our head office.

A larger edition—39" × 30"—printed on linen and suitable for hanging, can be obtained for half-a-Guinea, post free.

**WHITTAKER ELLIS**
**LTD.**

**54 Victoria Street, London, S.W.1**



PORTCULLIS "PORTETTE" PORTABLE GAS FIRE

*Design of unusual merit associated with advanced technical efficiency will continue to be characteristic qualities of the products of Bratt Colbran when peace-time manufacture is resumed.*

*Bratt Colbran Limited*

*Ten, Mortimer Street, London, W.1 West One*

MAKERS OF THE PORTCULLIS RANGE OF PRODUCTIONS

# WALWORTH SERVICE

## TUBES, FITTINGS, VALVES AND PIPE FITTERS' TOOLS

You can get them all, together; at the same time from any Walworth Depot. That's Walworth Service—always ready to assist you in supply problems. It saves time and trouble and helps to speed up the job.

**WALWORTH LIMITED**

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'Phone: Waterloo 7081

**MANCHESTER:**
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Manchester, 3
'Phone: Blackfriars 6773

**GLASGOW:**
48 York Street, Glasgow, C.1
'Phone: Central 6879

You can help us to supply your requirements for essential war work by showing on your orders the appropriate Government authority to buy.

WALWORTH
*Means Service*

# GAS METERS

FOR

# INDUSTRIAL ESTABLISHMENTS

MADE TO

# ANY CAPACITY REQUIRED

• • •

# SUTHERLAND METER CO. LTD.

110 GREAT HAMPTON ST.
BIRMINGHAM 19
Telephone: CENTRAL 2118

147–9 ST. JAMES'S RD.
CROYDON
Telephone: THORNTON HEATH 1331

In these days when the need for increased output is vital, a reliable Mechanical Handling Plant is absolutely necessary. Why not consult us? We can still supply to essential industries, and our sixty years' experience will ensure that you get the best possible plant for your particular job.

# COAL HANDLING PLANTS

The design and construction of Coal Handling Plants is one of our specialities. Many of the largest plants in the country have been manufactured by us.

SPENCER (MELKSHAM) LTD.
MECHANICAL HANDLING ENGINEERS
MELKSHAM · WILTS · ENG.

# REFRACTORIES

## FOR THE GAS INDUSTRY

ONE standard only is considered in the Glenboig organisation—the requirements of the exacting user. The maintenance of this policy demands the daily application of strict, impartial judgment, based upon accurately ascertained data obtained at each stage of manufacture. The fine laboratory at Glenboig is always master of these facts—and its technical staff ensure that the famous Glenboig quality is maintained. This is a difficult policy to apply—but to know that it is applied with notable success justifies the expectation that structures built with Glenboig Firebricks will possess longest life with lowest maintenance costs.

42/44% $Al_2O_3$ : **Glenboig Special** · **Glenboig Special Crown**
36/38% $Al_2O_3$ : **Glenboig** · **Glenboig Crown** · **Castlecary** · 34/35% $Al_2O_3$ : **Dykehead** · **Gem**

THE GLENBOIG UNION FIRE CLAY CO. LTD.
48 WEST REGENT ST. GLASGOW, C.2

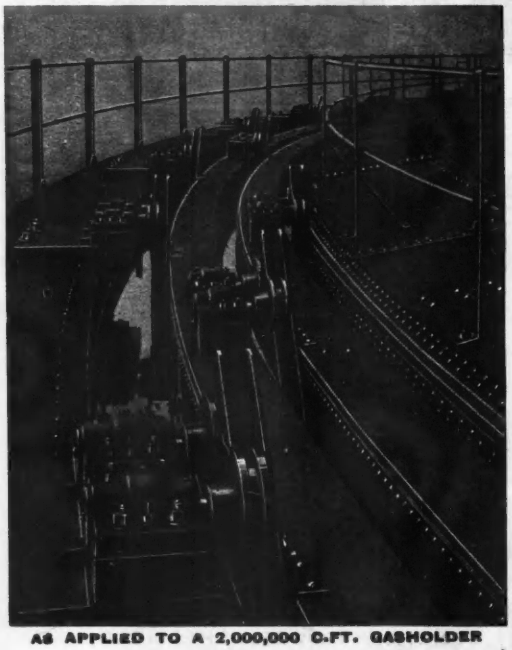
GENERAL REFRACTORIES LTD.,
GENEFAX HOUSE, SHEFFIELD, 10

# GLENBOIG

75

The Milne Meter

MILNE'S METERS LTD EDINBURGH AND LEEDS



AS APPLIED TO A 2,000,000 C.FT. GASHOLDER

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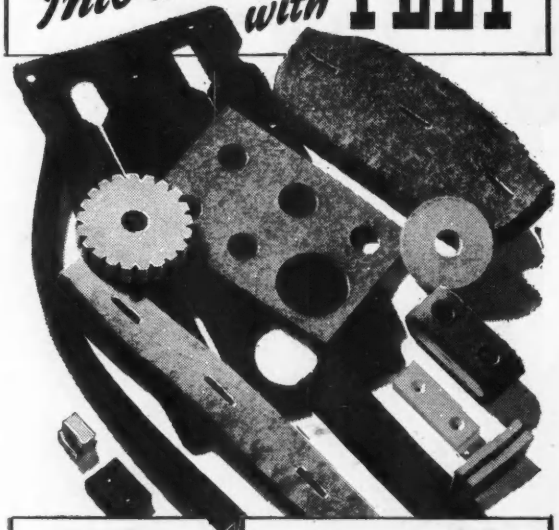

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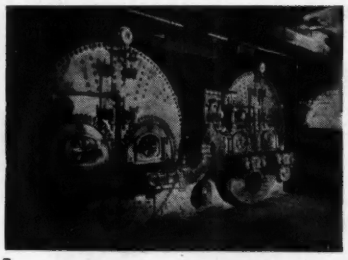

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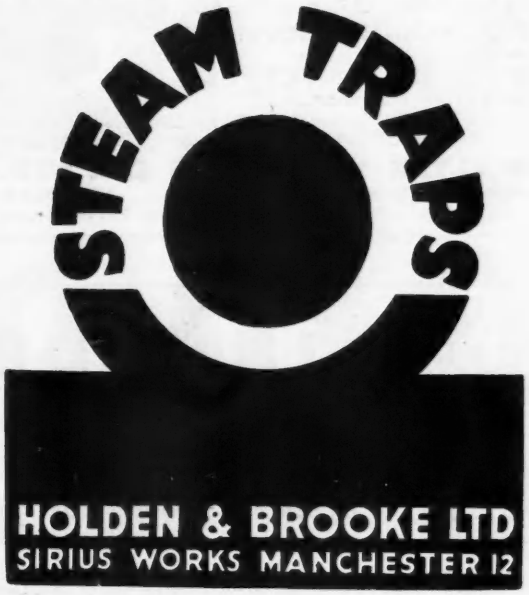

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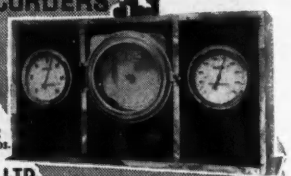

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